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PSEUDOSCORPIONS, A NATURAL CONTROL OF SIPHONAPTERA IN NEOTOMA NESTS*

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INTRODUCTION AND ACKNOWLEDGMENT

With the exception of Alphonsus' (1922) brief and unfinished work with pseudoscorpions in beehives, an investigation of pseudoscorpion feeding habits with respect to possible economic value has not been made. Upon finding large numbers of pseudoscorpions in *Neotoma* nests (*Neotoma, Citellus,* and *Cynomys* are the important plague reservoirs in the United States, Eskey, 1940) the writer conducted research from June 1953, to Feb. 1954, to determine (1) if pseudoscorpions feed on plague fleas, thus controlling them, (2) the extent of the control, and (3) the per cent of *Neotoma* nests with pseudoscorpions, as well as (4) the range within which pseudoscorpions occur in rodent nests.

At this time the writer wishes to express his thanks to Dr. Clayton C. Hoff of the University of New Mexico for identifying the pseudoscorpions concerned in this problem.

FIELD OBSERVATIONS. Wood rats are shown to be abundant in the south-west United States (Burt and Grossenheider 1952). A census taken in Lopez Canyon, which revealed a total of 151 wood rat nests along three-tenths of a mile of canyon road, gives an idea as to the possible magnitude of the *Neotoma* populations for this area. The wood rat, *Neotoma fuscipes* Baird, builds its nest in the low foothill regions, generally near an old creek bed where the vegetation offers a maximum of food and protection.

*Allan Hancock Foundation Contribution No. 174.

The huts are large structures made of sticks and bark and are three to four feet high. Each hut has many tunnels and rooms which contain stored food, a toilet area, feeding chamber, and nest cups in which adult fleas, developing larval fleas, and pseudoscorpions are found. For field data nest cups with surrounding and underlying material were collected in one-gallon bottles, processed in Berlese funnels, and the Siphonaptera and pseudoscorpions counted.

Pseudoscorpions were found to occur in *Neotoma* nests from Oregon to Baja California, eastward to Texas, and southward to Sonora, Mexico. Of 153 *Neotoma* nests collected in the San Gabriel Mountains, Los Angeles County, seventy-one per cent contained pseudoscorpions (mostly *Dinocheirus sicarius* J. C. Chamberlin and a possible new species of *Hesperochernes*) ranging from one to forty-four per hut.

During the summer months an average of eighteen adult fleas (*Anomiopsyllus nudatus* (Baker), *Anomiopsyllus falsicalifornicus* C. Fox, *Diamanus montanus* (Baker), *Hoplopsyllus anomalus* (Baker), and *Orchopeas s. sexdentatus* Baker, in order of greatest abundance) was found in nests without pseudoscorpions while nests with pseudoscorpions averaged twelve fleas, a reduction of one-third. A ratio of five adult fleas to three pseudoscorpions was also found. Favorable temperatures and humidities allow great increases in the flea population during the winter and spring months in Southern California (over 1400 fleas were found on a single occasion); however, the pseudoscorpion population within the rat nests also shows a marked increase at these times.

Feeding test observations. The examination of flea and pseudoscorpion populations in nature, though significant to this study, was not an accurate measurement of the pseudoscorpion's feeding habits. It was necessary, therefore, to determine by feeding tests what items of food would be eaten by the pseudoscorpion, to measure its preference, if any, and to obtain some idea of the volume of food it would eat at a given time. For these experiments hundreds of pseudoscorpions were isolated in separate one-and-one-half dram, cotton-stoppered vials, and fed selected items of food. One feeding test consisted of one three-hour feeding period for one pseudoscorpion with recorded observations every five minutes for one-half hour, and then every ten minutes for two and one-half hours.

Of one hundred pseudoscorpions offered adult fleas, eighty-eight were observed to feed; in contrast to this ninety-four of one hundred pseudoscorpions fed when they were offered flea larvae; and again ninety of one hundred pseudoscorpions fed on mites offered to them. Pseudoscorpions also fed upon Collem-

PLATE 1

A *pseudoscorpion* starting to feed upon an adult flea during a feeding experiment.

bola, beetle larvae, and small spiders but displayed little preference for these. When one hundred pseudoscorpions were offered adult and larval fleas simultaneously, sixty-six per cent chose larval fleas and thirty-four per cent chose adults. When offered adult fleas and mites simultaneously sixty-nine per cent chose the fleas and thirty-one per cent chose mites. In preference tests where larval fleas and mites were offered to the pseudoscorpions simultaneously, seventy per cent chose flea larvae while only thirty per cent chose mites. Compiled data of all preference tests show that 45.3 per cent of all pseudoscorpions chose larval fleas, 34.3 per cent chose adult fleas, and only 20.3 per cent chose mites.

Ten pseudoscorpions were fed continuously until they would no longer take any food. Fifty-three flea larvae were consumed by the ten in a matter of three-and-one-half hours. During another experiment twenty-four adult fleas were eaten by five pseudoscorpions. The results demonstrate that an average of about five adult or larval fleas can be eaten at one feeding time by a single pseudoscorpion. After twenty-four hours these same pseudoscorpions fed in only a languorous manner, indicating that they were not in any great need of food.

PLATE 2

A young *pseudoscorpion* has captured a flea larva prior to feeding. The larva is coiled around the *pseudoscorpion's* chelae.

Since pseudoscorpions feed by sucking body fluids from their prey it is the opinion of the writer that the preference displayed by them is based on the quantity of body fluids of one food type as compared to another. There is a direct correlation between the amount of body fluid of the food items and the preference displayed. The sizes of the mites, fleas, and flea larvae were as closely alike as possible to make these tests fair. The walking speed of the mite or flea as compared to the flea larva was a hindrance to the individual in that it walked into or around the pseudoscorpion more frequently than did the slower forms. In spite of speed or slowness the pseudoscorpion displayed preference in that it picked up and set aside, numerous times, any food item that it did not prefer until a suitable type was located, at which time feeding was begun. All other known forms of possible error or chance reaction were ruled out by the high number of feeding tests conducted.

Controlled hut observations. The controlled rat nests, designed to simulate natural nests, were used in the laboratory to check the results obtained in the field; in this way a strict control of the number of insects and pseudoscorpions was possible. The nests were constructed in large, flea-proofed battery jars that were furnished with straw and stocked with set numbers of fleas, pseudoscorpions, mites, Collembola, Thysanura, and other insects, and maintained for thirty-eight days, which gave ample time for the completion of an adult-to-adult life cycle of the flea. Fourteen controlled huts were set up, of which ten were carried to completion, the other four being eliminated when neighborhood boys released the wood rats. Results were based on the number of adult fleas present at the time of termination of the controlled experiments. At termination, huts containing pseudoscorpions averaged 19.4 fleas while huts without pseudoscorpions averaged 34.7 fleas. This reduction of fleas is roughly one third and closely matches the reduction found in nature.

Other observations. During the months of May and September it was common to find that the wood rat had removed its current nest cups, either intact or in part, and discarded them near the hut. It is possible that flea larvae may also be removed with the nest and left exposed to the killing rays of the sun.

Discussion. Locally pseudoscorpions were demonstrated in seventy-one per cent of the *Neotoma* nests, and were found to occur in rodent nests from Oregon to Baja California, eastward to Texas, and southward to Sonora, Mexico, which, according to the U. S. Public Health survey (Eskey) of 1935 is the same critical desert region in which the wood rat serves as the most important reservoir of sylvatic plague.

It was demonstrated that pseudoscorpions will and do eat adult and larval fleas as well as mites and other arthropods, and that they display a strong preference for the larvae, due perhaps to the higher body fluid content of this stage. The reduction of the flea population in nature by roughly one-third in the nests containing pseudoscorpions, as compared to nests without pseudoscorpions, would tend to substantiate this. Little doubt was left that pseudoscorpions do control Siphonaptera when test huts in the laboratory also demonstrated a one-third reduction as compared to control huts without pseudoscorpions. It is not the belief of the investigator that pseudoscorpions enter the nests for the sole purpose of obtaining Siphonaptera, but rather to obtain food in general. Once in the *Neotoma* nest pseudoscorpions are in a situation where it is possible for them to elminate tremendous numbers of Siphonaptera. Thus the pseudoscorpion may be considered important as a natural control for fleas and

thereby a controlling factor of the sylvatic plague. The information brought out in this investigation in general gives a greater understanding of the sylvatic plague problem, and when all data are considered, evidence warrants the recognition of the pseudoscorpion as a form of natural control of the plague flea in *Neotoma* nests.

SUMMARY

1. Pseudoscorpions are present in wood rat nests from Oregon to Baja California, and eastward to Texas and Sonora, Mexico. In this range the wood rat is the important plague reservoir animal.

2. Pseudoscorpions are present in over seventy per cent of the *Neotoma* nests in numbers ranging from one to forty-four.

3. There is a reduction in the flea population of about one-third in nests with pseudoscorpions as compared to nests without them. The number of fleas is inversely proportional to the number of pseudoscorpions.

4. Pseudoscorpions enter the *Neotoma* nests to obtain all forms of food, and not solely for Siphonaptera.

5. Feeding experiments proved that pseudoscorpions will eat adult and larval fleas as well as other anthropods, and that they prefer flea larvae to other forms of food.

6. The controlled hut experiments demonstrated a one-third reduction of the flea population identical with that found in nature.

7. Such domestic habits of the wood rat as nest rebuilding may be a minor controlling factor.

8. Pseudoscorpions in the *Neotoma* nests are reducing the flea population which in turn retards plague transmission.

9. Evidence warrants the recognition of pseudoscorpions as a form of natural control of plague fleas in *Neotoma* nests.

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FOUR NEW PREDACEOUS MITES (ACARINA, PHYTOSEIIDAE)

By PHILIP GARMAN AND E. A. MCGREGOR

In a study by McGregor of the mites found to occur on citrus in southern California, four species received special attention by Garman in the matter of identification. Accordingly the present paper has been prepared to appear in advance of the principal publication, so that established species names may be had for reference.

These phytoseiid mites are predaceous, and many of them are important enemies of the phytophagous tetranychid mites, or "spider mites," and hence are of economic importance.

Garmania lewisi new species

Plate 3, figs. 1, 2, 3.

MALE.—Dorsal setae in number and arrangement that of *Garmania bulbicola* (Oudemans), as figured by Nesbitt for the female, but the length of these setae is distinctly longer in the present species. The outline of the sterni-genital scutum is rather ill-defined in our species, but it has 5 pairs of setae and 4 anglulations each side. The posterior boundary of the genital portion of this scutum is somewhat indistinct. The anal plate is expansive, occupying most of the area behind coxae IV; it is subcordate in outline, and distinctly sculptured; it bears 14 longish setae, 3 transverse rows of 4 each, and one each side marginally opposite anterior face of anus; one pair of setae on anus. Anterior appendages of hypostome with each external mala basally bearing internally two somewhat separated spines. The median hypostomal structure, between the malae, bearing laterally along its midregion a fringe of fine setae. Anterior pair of ventral hypostomal setae not stronger than others. Hypostomal teeth either lacking or extremely minute.

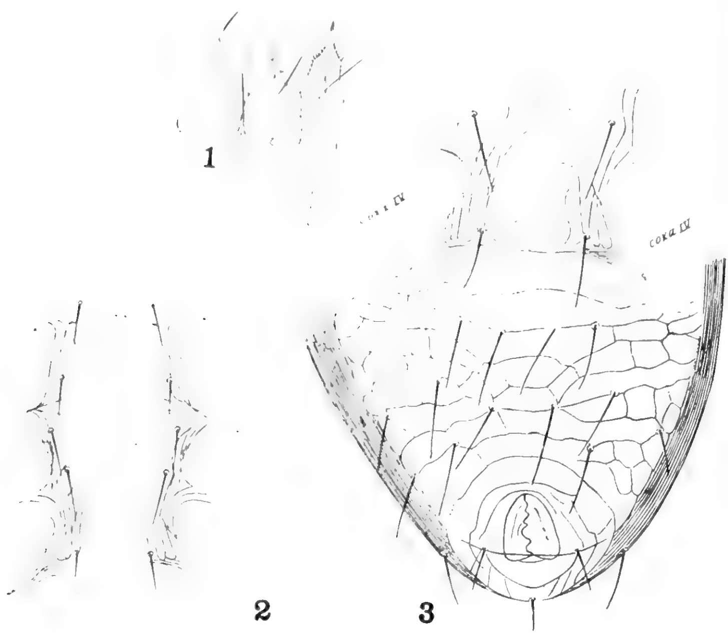

PLATE 3

Garmania lewisi n. sp.: fig. 1, ventral view of hypostome; fig. 2, sternal-genital plate and coxal bases; fig. 3, posterior venter and associated setae.

Holotype male.—No. 8-21-54, on orange, Irvine, Calif., Aug. 16, 1954, collected by H. Lewis. Deposited in the collection of the Los Angeles County Museum. Also on slide 9-8-54, on orange, Irvine, Calif., Aug. 24, 1954, collected by Lewis.

Typhlodromus citri new species

Plate 4, figs. 1, 2, 3, 4, 5, 6

Female.—Resembling *T. conspicuus* (Garman), but differing in several particulars, as confirmed by E. W. Baker. With 8 pairs of marginal setae on dorsal shied, mostly short; seta M-2 and L-8 the longest; seta M-2 not paired with any other seta, nearly equidistant from D-5 and L-8. An interscutal seta laterad of seta

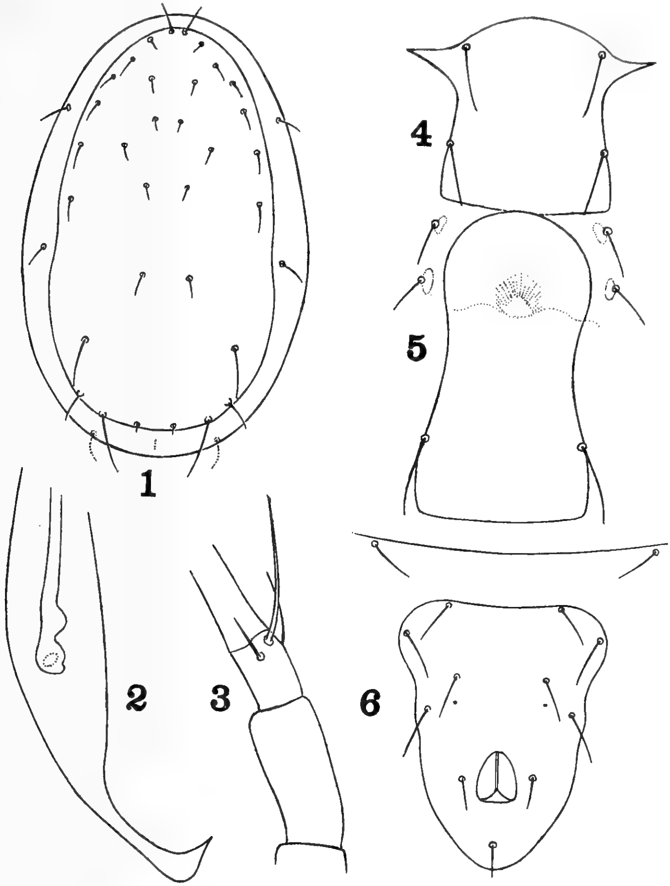

PLATE 4

Typhlodromus citri n. sp.: fig. 1, dorsum showing setal details; fig. 2, peritremal plate; fig. 3, setae on base of tarsus IV; fig. 4, sternal plate; fig. 5, genital and metapodal plates; fig. 6, ventrianal plate.

L-4, and one well behind L-6. Sternal scutum roughly rectangular, with 2 pairs of setae, and with humeral angles prominently pointed. Two pairs of metapodal plates, each with a seta. Genital plate thimble-shaped, gently convex behind, with a pair of setae. Anal plate sagittate, broadest anteriorly, somewhat wider than genital scutum, with 4 pairs of pre-anal setae; a fine pore behind each second inner seta. Peritreme reaching anteriorly to seta D-1, recurved posteriorly like the head and neck of a bird. Tarsus IV with a rather long seta.

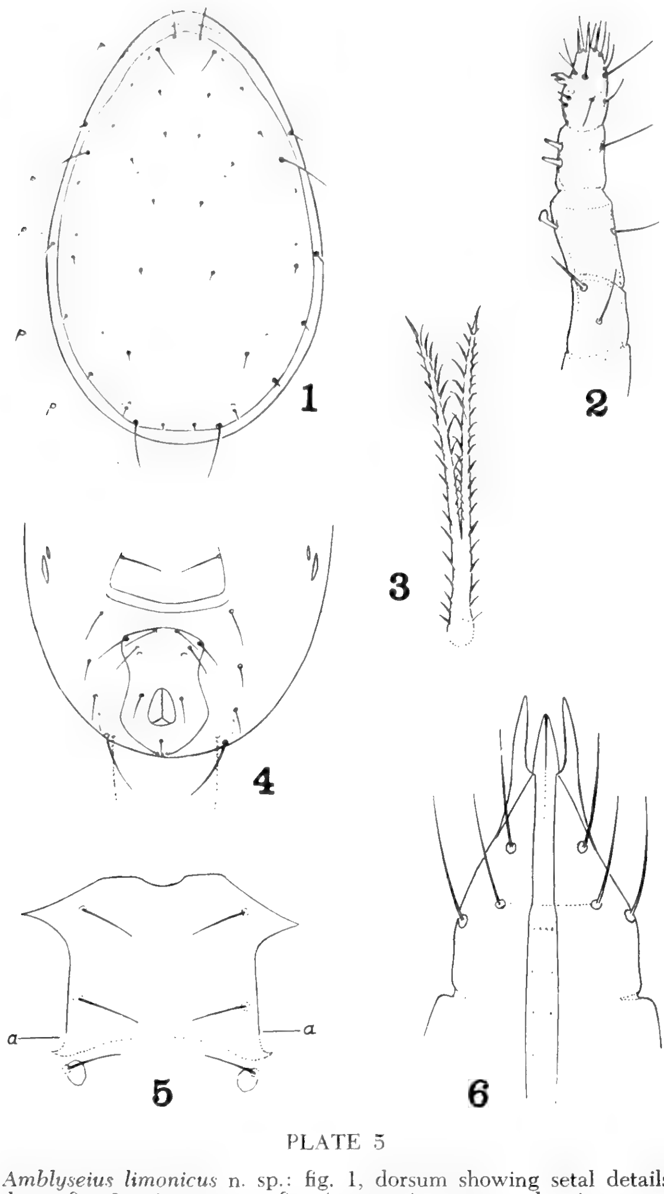

PLATE 5

Amblyseius limonicus n. sp.: fig. 1, dorsum showing setal details; fig. 2, palpus; fig. 3, tritosternum; fig. 4, posterior venter, showing ventrianal scutum and associated setae and parapodal plates; fig. 5, sternal scutum and metapodal plates; fig. 6, hypostome.

HOLOTYE FEMALE No. 4-18-52, on lemon, N. Whittier Heights, Calif., April 18, 1952, collected by F. Munger. Deposited in the collection of the Los Angeles County Museum. Also No. 9-27-53, on lemon, Whittier, Calif., Sept. 27, 1953, collected by Munger; also No. 54-2-1, on lemon, Camarillo, Calif., Dec. 17, 1953, collected by H. Lewis; and No. 4-23-54, lemon, N. Whittier Heights, Calif., May 1953, collected by F. Munger.

Amblyseius limonicus new species

Plate 5, figs. 1, 2, 3, 4, 5, 6.

FEMALE. Dorsum with lateral setae 1, 4 and 9 longer than others, though not as long as in other members of the genus. Dorsals very minute, two small scapulars; pores as in figure 1. Integument smooth. Chelicerae with 7 to 9 teeth on fixed arm. Palpi each with a spatulate seta on the inside of segment 3. Epistome of usual form—the cornicles slender, somewhat approximate. Leg IV with longer setae on genual, tibia and first tarsal segment. Anal plate (fig. 4) expanded anteriorly, with forward setae grouped somewhat as in *T. finlandicus*, but the spacing between the setae more unequal and the middle pair nearer the anterior margin. Two lunate pores as in fig. 4. Sternal plate with two setae each side and an almost circular metapodal plate behind caudo-lateral angle on each side. Parapodal plates consisting of a slender, almost needle-like pair each side, the smaller about 1/5 as long as the larger. Peritreme plate blunt at posterior end, but not as squarely truncate as in some members of the genus. Tracheae each side extending forward to coxa I or almost in line with seta D^1. Genital armature semicircular in appearance, with lines radiating from the anterior margin.

MALE not available.

FEMALE, *Measurements*. Length .198-.240 mm., width .135 mm., leg IV .255-.285 mm., seta L^9 .048-.056 mm.

HABITAT. Found on orange and lemon, California, presumably feeding on Tetranychidae. Santa Ana, Sept. 20, 1940, McBurnie Coll.; Carpinteria, Nov. 11, 1954, Lewis Coll.; Goleta, Oct. 4, 1953, Hall Coll.; Chula Vista, Aug. 5, 1935, Jones Coll.

HOLOTYPE Santa Ana slide; Garman Lot 40-21386. Deposited in the Connecticut Agricultural Experiment Station collection. Also a slide, McGregor Lot 11-9-54.

NOTES. The anal plate of this species strongly resembles that of *Typhlodromus finlandicus*, but there is a noticeable difference in the spacing of the setae in relation to one another. There is also an importance difference in the length of the tracheae, which extend much farther forward than those of *finlandicus*. In addi-

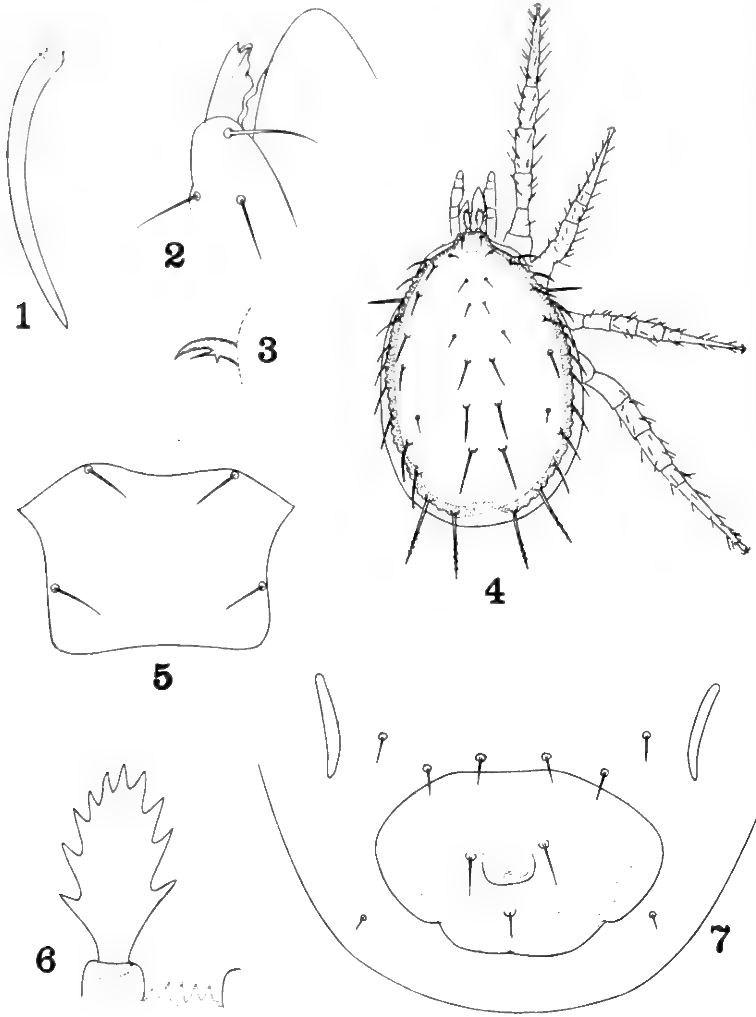

PLATE 6

Ameroseius californicus n. sp.: fig. 1, seta D^5, fig. 2, ventral view of right side of hypostome; fig. 3, forked seta on palp-tarsus; fig. 4, dorsal view of mite; fig. 5, sternal plate; fig. 6, one of the leaflike setae at front apex of body; fig. 7, posterior venter, showing ventrianal scutum, parapodal plates, and associated setae.

tion, the chelicerae bear a conspicuous row of teeth, not seen in *finlandicus*. The greater length of the lateral setae, as mentioned above, and the small size of the dorsals, places it in *Amblyseius*.

Ameroseius californicus new species

Plate 6, figs. 1, 2, 3, 4, 5, 6, 7.

The senior author examined this mite and concluded that it probably belongs in the genus *Ameroseius*, and is probably undescribed.

FEMALE.—Dorsum evidently with 11 pairs of lateral setae; L^8 and L^9 are shorter than L^{10}. There appear to be 7 pairs of interscutal (?) setae anterior to setae L^8. The median dorsal setae (or spines) increase gradually in length from front to rear. Most of the body setae are thick-lanceolate, with weak secondary pectinations. A pair of plumate setae borne at front tip of body. Dorsal integument mosaic. Sternal scutum sub-rectangular, bearing 2 pairs of setae, with humeral angles rather prominent. Metapodal plates ovate, rather acutely pointed mesad. Parapodal plates one each side, banana-shaped. Ventri-anal scutum ovate, much wider than long, posterior margin scalloped, bearing one pair of paraanal setae, and a post-anal seta. A row of 4 setae immediately in front of anterior margin of ventri-anal scutum. One seta mesad of each parapodal plate. Forked sensory seta of pedipalp with a small secondary spur on inner spine. Chelicera with 3 rounded teeth on the fixed arm. All legs with only short setae. Peritreme extending anteriorly to seta D^1.

This species differs from Berlese's *hirsutus* in the chaetotaxy of the posterior venter, outline of the anal plate, shape of the metapodal and parapodal plates, and in the length of the various dorsal and lateral setae.

HOLOTYPE FEMALE No. 3-31-55, citrus, near Stanton, Calif., March 31, 1955, Collected McGregor. Deposited in the collection of the Los Angeles County Museum. Four mites (*Typhlodromus* sp.) also on this slide.

A REMARKABLE NEW RHAGOVELIA FROM THE DOMINICAN REPUBLIC

(Hemiptera: Veliidae)

By C. J. Drake[1] and J. Maldonado-Capriles[2]

During the latter part of last December (1955), the junior author spent ten days collecting Hemiptera in the Dominican Republic of the West Indies. Among the aquatic Hemiptera netted, there are several specimens of an undescribed ripple-strider belonging to the genus *Rhagovelia* Mayr. This peculiar water-treader differs from all its congeners of the Americas in having the third segment of the antennae in the male very strongly dorso-ventrally compressed so as to make it very broad, thin, nearly flat and nearly elongate-ovate in outline. In female specimens this segment is not modified, is cylindical and similar in general aspect to that found in other members of the genus. As almost all of described species of *Rhagovelia* are represented in the collection of the authors, we feel that the strongly modified third antennal segment should be treated as a specific character peculiar to the male sex of the new species characterized below.

Rhagovelia secluda, n. sp.

Plate 7 figs. 1-4

Apterous form: Moderately large, black, with the transverse, subapical, orange band divided at the middle; anterior third of pronotum and entire body beneath heavily coated with bluish pruinose; all acetabula stramineous. Head with median longitudinal line and V-shaped basal mark impressed, black, shining; beset with the usual long bristly hairs; anterior part of frons brown, lightly frosted; rostrum testaceous, with terminal segment and inferior side blackish; eyes blackish; width across eyes, 0.80 mm. Antennae blackish fuscous with base of proximal segment testaceous or stramineous, clothed with short dark brown pubescence, the first two segments with the usual long bristly hairs; segment III (male; fig. 1) very strongly dorso-ventrally flattened, thin, elongate-ovate, or (female) cylindrical and not modified, measurements—(male) I, 90; II, 30; III, 55; IV, 45 and (female) I, 86; II, 30; III, 55; IV, 18.

[1] Iowa State College, Ames, Iowa
[2] University of Puerto Rico, Mayagues, P. R.

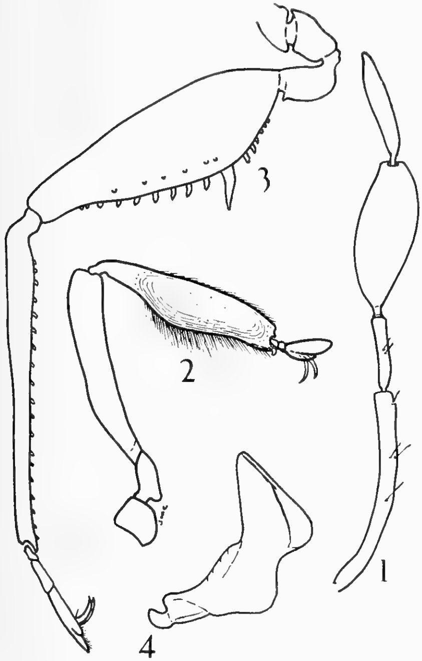

PLATE 7

Rhagovelia secluda, n. sp. (male). Fig. 1. Antenna. Fig. 2. Left fore leg (inferior side). Fig. 3. Right hind leg (anterior side showing ventral spines. Fig. 4. Right male paramere.

Pronotum produced posteriorly, covering about two-fifths of mesonotum in both male and female, broadly rounded behind, the width across orange band less than twice median length (90:50); mesonotum with uncovered part shorter than pronotum (38:50), sharply obliquely narrowed posteriorly on both sides, with apex fairly wide and feebly rounded, the width across apex much narrower than its width just behind pronotum (54:105); metanotum not visible behind mesonotum but uncovered on each side of posteriorly narrowed sides of mesonotum.

Legs (male; figs. 2 & 3) black-fuscous, with basal part of anterior femora, all coxae and all trochanters stramineous or testaceous, pubescent, with the usual long, black, bristly hairs. Anterior legs (fig. 2) with femora subcylindrical, with a thin row of long black hairs on median line of inferior surface, subequal to tibiae in length (98:97); tibiae strongly dilated beyond the basal two-fifths, widest in front of middle, with superior surface

slightly convex, with inferior side broadly longitudinally scooped out on the apical three-fifths (fig. 2), the anterior edge beset with a long brush of moderately long, dense, stiff, brownish hairs; tarsi with first two segments very short, the third moderately long; measurements—femora, 98; tibiae, 96; tarsi I, 4; II, 3; III, 24. Middle legs very long, slender; tarsi III with a deep apical cleft (about five-sevenths of the length of the segment), with the usual fanlike, plumose hairs arising from the bottom of the cleft; measurements—femora, 180; tibiae, 150; tarsi I, 3; II, 80; III, 70. Hind legs (fig. 3) with femora moderately swollen, thickest at basal two-fifths, there provided with a long, stout spines (all spines slightly bent outward), which is preceded by four or five very short spines and then followed by nine or ten short spines (each decreasing in size apically), also provided with another row of five to seven spines in front of and parallel to median row (first spine placed opposite long spines—spines short and a little difficult to find); tibiae straight, feebly tapered apically, without a distinct spur at apex, armed beneath with a median longitudinal row of fifteen to eighteen, short, stout spines;—tarsi I, 5; II, 16; III, 31. Male parameres as in fig. 4.

Legs (female): Color and bristly hairs as in male; anterior tibiae scarcely widened apically; hind femora very little swollen, sometimes with a short spine near apical fifth of inferior surface. All coxae and trochanters unarmed in both sexes. Measurements (middle legs)—femora 160; tibiae, 140; tarsi I, 4; II, 80; III, 70 and (hind legs)—femora, 140; tibiae, 160;—tarsi I, 5; II, 16; III, 30.

Abdomen (male) slightly tapered posteriorly, with last tergite nearly one-half longer than preceding segment; connexiva reflexed obliquely upwards, slowly narrowed posteriorly, not produced at apex, terminating at end of last tergite in a narrow, acute angle. Male parameres fairly large, shaped as in fig. 4. Abdomen in female more tapering posteriorly than in male; last tergite much longer than preceding segment, the last ventrite deeply roundly excavated on hind margin (slightly more so at middle); connexiva strongly reflexed, with last three segments resting on surface of abdomen but with outer margins not meeting within; last tergite and ends of connexiva provided with dense patches of long black hairs; exposed basal tergites (not concealed by reflexed connexiva) provided with pubescence, the other tergites almost nude. Macropterous form of both sexes unknown.

Length, 3.90 mm. (male) and 4.15 mm. (female); width, 1.35 mm.

Type (male) and allotype (female), on the road from Contanza to Valle Nuevo, Province de la Vega, Dominican Republic,

altitude 6,000 feet, along the margin of a small stream, Dec. 27, 1955. Paratypes; 7 specimens, taken in same school as type, also 3 nymphs. Type in Drake Collection.

The antennal and leg characters distinguish this insect at once from other members of the genus; it belongs to the group of *Rhagovelia*, which have the pronotum (apterous form) produced posteriorly so as to cover around half of the mesonotum. The flattened third antennal segment of the male is peculiar to this species.

A NEW CANTACADERID FROM BRASIL

(Hemiptera:Tingidae)

By CARL J. DRAKE[1] AND F. PLAUMANN[2]

Up to the present time, the genus *Zetekella* Drake (1938) has been known only from the genotype (*Z. zeteki* Drake) collected in Panama. The present paper describes a second species of the genus from southern Brasil. The following notes are intended to supplement the original generic description;—

Head moderately long to long, subquadrate, armed with five stout spines—three anterior spines and a pair between these and eyes; no spines between or behind eyes. Bucculae long, parallel-sided, open in front, the ends slightly surpassing apex of head. Rostrum extremely long, extending on venter. Antennae moderately long(slender, pubescent; segments I and II very short, with tip of latter barely surpassing apex of head; III longest, straight, very little thinner than others; IV moderately long, provided with longer pubescence. Macropterous form unknown.

In size, form and general aspect, the two described species of *Zatekella* resemble members of the genus *Acalypta* Westwood (1840). However, the subfamily characters of Cantacaderinae Stal (1873) separate at once *Zetekella* from *Acalypta* and other genera of Tinginae.

Zetekella pulla, n. sp.

BRACHYPTEROUS FORM: Small, ovate, brown with head and pronotum black and collar white, slightly shining, especially pronotum. Female broader than male. Long-winged form unknown. Length, 1.75-2.00 mm.; width, 1.00 mm.

[1]Iowa State College, Ames, Iowa.
[2]Santa Catarina, Novateutonia, Brasil.

Head rugulose, fairly long, considerably produced in front of eyes, with apex extending slightly beyond tip of second antennal segment, armed with five, rather short, stout spines (all spines in front of eyes; median directed forward, the two pairs suberect). Antennae brown, rather short, fairly slender, rather densely pubescent, measurements—I, 5; II, 4; III, 31; IV, 16. Antennal tubercles short, stout, rounded at apex, black-fuscous. Rostrum very stout, white-testaceous, very long, with tip reaching second ventrite; laminae black-fuscous, areolate, open behind.

Pronotum nearly flat, obliquely narrowed on sides anteriorly, almost trapezoidal in outline, with front margin truncate, unicarinate, the median carina distinctly elevated, uniseriate, with a few extra areolae near middle; collar biseriate, mostly whitish; paranota not very wide, slightly reflexed, biseriate, the areolae small; calli small, impressed, impunctate; posterior margins subtruncate (slightly obtusely angulate at middle). Scutellum small, black, exposed. Areolae of collar, paranota and pronotum nearly equal in size, slightly smaller in median carina. Outer margins of pronotum and superior margin of median carina beset with numerous, very short, pale spinulae. Ostiolar orifice with a circular opening. Dorsal surface of pronotum sparsely provided with erect, pale, seta-like pubescence. Legs rather short, moderately slender, brown, clothed with short, pale pubescence.

Elytra rounded, much wider than pronotum, widest near basal fourth, there distinctly wider than widest part of pronotum (90:55), with inner margins meeting in a straight line down the middle of the abdomen, with outer margins beset with numerous, short, setalike hairs; boundary veins separating subcostal, discoidal and sutural ares provided with erect, setalike hairs; dorsal surface with setalike hairs more numerous than on pronotum; costal area moderately wide, the areolae moderately large, hyaline and arranged in regular rows; subcostal area wider than costal, quadriseriate, the areolae nearly as large as in costal area; clavus fused and not distinctly set-off; discoidal area elongate-ovate with apex extending beyond middle of elytra, four areolae deep at middle; sutural area small (short-winged form). Abdomen beneath brown, the sternum black.

Length, 1.85-2.00 mm.; width, 0.90-1.05 mm.

Type (male) and allotype (female), Nova Teutonia, Brasil, June, 1955. Paratypes: 2 specimens, same data as type. Type in Drake Collection.

Separated from *Z. zeteki* Drake by cephalic spines and elytral areas as discussed above.

NOTES ON METAMORPHOSES OF THE GIANT SKIPPERS (LEPIDOPTERA; MEGATHYMINAE) AND THE LIFE HISTORY OF AN ARIZONA SPECIES

By JOHN ADAMS COMSTOCK

The "Giant Skippers," or "Yucca Borers" are a group of butterflies that occur in the southern states, particularly in areas where yuccas and agaves are abundant. They are also found in Mexico.

Two genera are represented in the subfamily. The first is the genus *Aegiale,* with a single species,—*hesperiaris* Walker, occurring in Mexico. The larvae of this species feed within the fleshy leaves of certain century plants (Agaves), called Maguey by the natives, particularly the species from which pulque and tequila are made. These large, fat 'grubs' are highly prized as food by the natives. The choicest bottle of tequila, put up for home consumption, contains one of these delicious caterpillars, floating directly under the cork.

The second genus of the group is *Megathymus,* with numerous species recorded from California, Arizona, Texas, Florida and adjacent states, with a few from Mexico.

The first species to receive a name was *Megathymus yuccae* (Boisduval & LeConte). This was published in 1833 as *Eudamus yuccae,* and with it appeared the first life history record.[1]

One hundred years later the number of new species or varieties in this genus which had been described for boreal America stood at only 13, and the references to early stages and foodplants totaled only 17.

In a group that is as intriguing as this, it seems strange that forty-three years had to pass (1833 to 1876) before any additional information was published on life histories. It was not until 1876 that C. V. Riley published his first two papers on *Megathymus yuccae,*[2] and laid the groundwork for an understanding of the developmental phenomena of that large group within the genus which are yucca borers.

The past twenty-one years have added 10 or more species or races, and the references in the literature to life histories, food-

[1] Lep. Am. Sept. pl. 70. 1833

[2] Trans. Acad. Sci. St. Louis. pp. 323-344. 1876, and Eighth Missouri Rep. pp. 168-183. 1876.

plants and habits have totaled 27, as may be noted in the bibliography supplementing this paper. Possibly this list may be increased by some obscure references that have escaped our notice.

There was another segment of this genus, feeders in the fleshy leaves of agaves, that had to wait a much longer time before the secrets of their childhood were disclosed.

A hint had been given in 1912, when Henry Skinner published *Megathymus stephensi*,[3] and quoted Ricksecker that "it feeds on *Agave deserti*."

However, no actual account of the life cycle of any agave feeder saw the light of day until the writer, in association with Commander Charles M. Dammers of Riverside, California, published and illustrated the metamorphosis of *M. stephensi* in 1934,[4] just one hundred and one years after the first megathymid was described.

The circumstances associated with the first finding of the larva of *stephensi* may be of some interest to California lepidopterists.

It had long been surmised by local collectors that some intimate association must exist between *Agave deserti* and *Megathymus stephensi*, since the two were always found in the same territory.

Early in October of 1932 I decided to make an attempt to solve the problem, and, taking advantage of a short vacation period, my wife and I left for the desert on October 8.

Our planned destination was "La Puerta" in the lower end of Mason Valley, San Diego County, a region that had been named by the veteran naturalist, Frank Stephens, who had made it famous in zoological circles by the many records of mammals, birds, reptiles and insects which he had collected there.

Our route led by way of Julian, down the Banner grade to the San Felipe junction of the old Butterfield stage road leading toward Box Canyon. On reaching Julian we ran into rain, which increased to the point where the Banner grade, then unsurfaced, became a mud toboggan.

About a third of the way down we skidded into an upcoming car, which ripped off our left fender and upset our equanimity. Then back to Julian for an analysis of damage, which proved to be slight in comparison with the jolt to our nervous systems.

Our ardor was not unduly damaged. We were urged on by the tradition that "it never *really* rains in Mason Valley."

[3] Ent. News. XXIII: (3) pp. 126-127. 1912.

[4] Bull. So. Calif. Acad. Sci. 33: (2) pp. 79-86. 1934.

Down the grade our progress was smooth, as would be expected on a mud toboggan. In the lower altitude of the junction we expected a let-up in the downpour, but no; still came the rain, and the old Butterfield wagon tracks looked the consistency of liquid butter.

There was no turning back here. The vision of a sunny Mason Valley lured us on. The windshield-wiper groaned along in its effort to maintain visibility. After topping the ridge at the southeastern end of San Felipe Valley, we noted a small dry lake bed, with surrounding hills that were well covered with agave. Here was a good place to begin operations, rather than risk the Box Canyon.

Rain or no rain, we must make a dissection of an agave, from crown to root. That is no easy task, with water trickling and tickling down one's back, and serrated century-plant leaves sawing at one's knees. The stalk took time, with no results. The fleshy leaves were tough, and hard to remove,—but what was that dark stain at the base of one of them! A cavity within, and — Eureka! at last, a plump and luscious grub; a chamber, and an antechamber with an opaque window. Now we knew how to search for the hidden treasure.

The elemental forces now opened a bombardment of thunder and lightning, and research was over for the day. A soaked and sloshing return was made to camp, and it became evident that we would have to make the best of it that night, holed up in cramped positions in the car.

But, what mattered the deluge! I had what was presumably the larva of *stephensi*, and soon its secrets could be published — the story poured forth for the benefit of the many thirsty lepidopterists, so eager to soak up information, and so desirous of seeing their cabinets brimming over with beautiful reared series of megathymids.

It takes a lot to dampen the enthusiasm of an entomologist, but that lot fell that night, to the accompaniment of vivid flashes, and the almost continuous roll of thunder. Seven inches of rain poured down on one of the most arid spots in California. We bedded down in a car, located on the edge of a dry lake bed. The morning light found us, an island in an inland sea, with waters lapping at the running boards.

We waded ashore to cut creosote bush, and crammed it under the wheels, in an effort to obtain traction, but to no avail. Starting the car succeeded only in grinding deeper into the mud.

"The rain was over and gone." The only thing to do was walk back over the way we came. Normal California desert sunshine

had returned, the "time of the singing of birds had come," and the six or seven-mile walk along the wash that had been a road was not a hardship. In the first ranch house we encountered, a hospitable elderly gentleman helped to raise the morale of Mrs. Comstock, while I trudged on to a not very distant telephone.

A call to Julian brought a well equipped truck, with power winch and steel cable, which pulled us out of the mud instanter.

Thus ended the adventure phase of our expedition.

All that remained to complete the picture was for our team, (Comstock and Dammers) to work out the details, take the necessary photographs, make the paintings, develop certain refinements in collecting and rearing methods, and finally to publish the account which I have previously cited.

* * * * *

This past summer, with the help of Dr. Francis X. Williams, I had the opportunity of adding another chapter to the life cycle story of the agave feeders.

We two were camped in Miller Canyon, one of three well-known collecting spots at the eastern end of the Huachuca Mountains of southern Arizona, not far from the old townsite of Palmerlee.

A short distance to the north was Carr Canyon, and beyond it, Ramsay Canyon. These are historic sites to the lepidopterist, for there, in the early days, worked Poling, Biedermann, and others gathering specimens which were destined to find their way into important collections, many of them to be recorded as types, or in type series.

On July 26, while I was polishing up field notes and making sketches, Dr. Williams scouted the nearby terrain. With his trained eye, and keen insight into the ways of insects, he turned up several larvae of various genera, that were new to us. Some of these will later be recorded in life history papers. One, however, was the larva of an agave feeding megathymid. This 'find' resulted in an agave reconnaissance, from which we returned with a good series of larvae, and much valuable data.

The specimens thus secured were finally carried to maturity and a good series of imagos were ready for determination.

They proved to be *Megathymus evansi* Freeman, a species described in 1950,[5], the type locality being Ramsay Canyon.

The name has been considerably knocked about of late, a veritable shuttle-cock of the battledorean systematists.

[5] Field & Laboratory, XVIII: (4) p. 144, 1950.

Bell and dosPassos maintain[6], as does also Freeman, that *evansi* is a valid species. Stallings and Turner hold that it is a synonym of *aryxna* Dyar,[7] and there is rumor that a ruling may be asked of the International Commission to settle the matter.

It would take pages to review all the aspects of this controversy. For the present, we feel that Ernest L. Bell *et al* have a little better logic in their contention, and we will continue to call Freeman's Ramsay Canyon species *Megathymus evansi.*

* * * * *

LIFE HISTORY NOTES ON *Megathymus evansi* Freeman

The author of this species, published (1951), an interesting note on the method of oviposition of *M. evansi,* and recorded the foodplant as *Agave Parryi* Engelmann.[8]

He reported seeing a female "flip two eggs into one of the plants." We had previously recorded much the same action by a female *M. stephensi* while in captivity, in our published record of that species.

Apparently this practice is common to most, if not all of the agave feeders.

The young larvae crawl to the tip of a leaf, and burrow in. They then gradually tunnel down to a final position near the base of the leaf, excavate a roomy chamber, and construct a minute opening, which is kept sealed most of the time.

In the case of *evansi,* this opening or window is usually on the upper surface of the leaf, but a few were found on the under surfaces. The opening is not as easily observed with this species as is the case with *M. stephensi.*

MATURE LARVA OF *M. evansi*

Length, fully extended, 38 mm. Greatest width, 8 mm.

Cylindrical, and grub like in appearance. It is widest through the sixth to ninth segments, thence tapering gradually towards the head, and more acutely to the cauda.

Head: rugose, small, (width 3 mm.), reddish brown, with the front slightly darker. Ocelli concolorous with the face. Mandibles, black.

The entire head is covered with short, light yellow pile.

Body: ground color, light plum-olive, but appearing almost

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[6] Am. Mus. Novitat. No. 1700. pp. 1-5. 1954.
[7] Lepidopt. News. 8: (3 & 4), pp. 77-87. 1954.
[8] Field & Lab. 19: (1), p. 28. 1951.

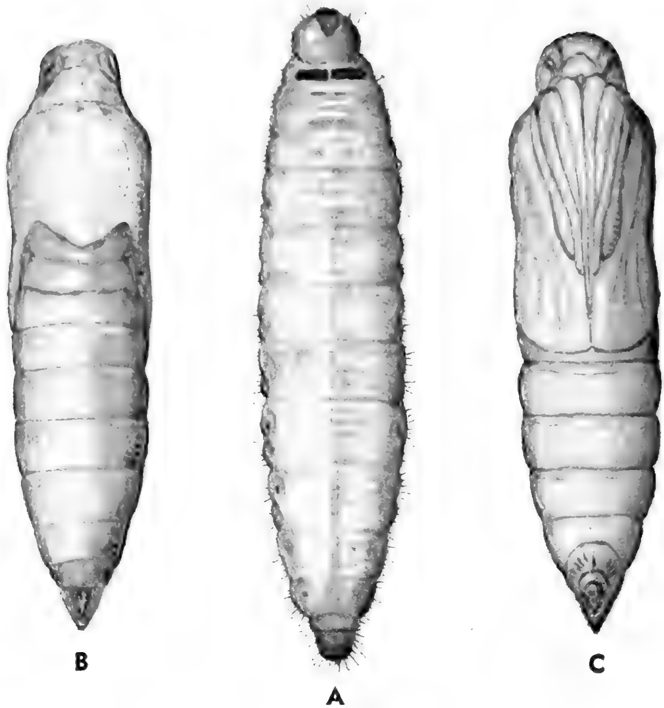

PLATE 8

Larva and pupa of *Megathymus evansi* Freeman. Enlarged approximately X. approximately 2¼. A. Larva, dorsal aspect. B. Pupa, dorsal aspect. C. Pupa, ventral aspect. Reproduced from painting by the author

white because of the powdery covering. There is a black scutellum on the first cervical segment. This is cleft on the mid-dorsal line, dividing it into two elements.

A narrow mid-dorsal pulsating dull green line is present, which becomes more conspicuous caudally.

The caudal tip is blackish brown. Spiracles narrowly rimmed with black. Legs small, and slightly yellower than body, but with darker tips. Prolegs and anal prolegs concolorous with body. Crochets very light olive-brown. Minute yellowish hairs are thickly scattered over the body.

The larval burrow and hinged opening are the same as we recorded for *Megathymus stephensi*, and the chamber is lined with the same type of flocculent white powder shortly before pupation.

PUPA.

Length, 33 mm. Greatest width, 8 mm.

The pupa is similar in general appearance, and has the same habits as that of *M. stephensi.* The essential differences are that it lacks the mid-dorsal dull green line, and the head is relatively narrower and more rounded.

When the white powder is removed the segmental lines are distinguishable, and the body ground color is revealed to be a light brown or tan, with a still lighter shade on the wing cases. Spiracles concolorous with the body. Cremaster, dark brown at the tip, ending in a triangular plate, devoid of hooks.

On superficial examination, the body appears to be entirely devoid of pile, but magnification brings out the presence of a sparse covering of minute white hairs.

The larva and pupa of *M. evansi* are illustrated on Plate 8.

A comparison of this plate with the photographs of the larva of *M. stephensi* demonstrates the very considerable difference between the two species. The robust larva of *stephensi,* with its acute tapering at the last caudal segments will alone put it in a different category.

In my opinion, *Megathymus stephensi* is a distinct species, with no close relationship to *neumoegeni. M. evansi,* on the other hand, may be a branch in the *neumoegeni* family tree.

ACKNOWLEDGMENTS

I am particularly indebted to Dr. H. Avery Freeman, of Garland, Texas, and Don B. Stallings, of Caldwell, Kansas, for their generosity in supplying reprints of their papers and other courtesies. Without the skilled assistance of Dr. Francis X. Williams, of La Mesa, California, I would not have been able to obtain the Miller Canyon material which prompted this study. Dr. Hildegarde Howard has kindly checked the manuscript, and suggested certain helpful alterations.

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A NEW SPECIES OF *STEGOCEPHALUS* (Amphipoda Gammaridea) FROM CALIFORNIA

By D. E. Hurley

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The species here described was taken amongst collections made by the research vessel Velero III. The Family Stegocephalidae has not been recorded previously from the West Coast of America south of Kyska Harbor and Point Barrow, Alaska (Shoemaker, 1930).

I am greatly indebted to Captain Allan Hancock and the Hancock Foundation for the opportunity to work on this material. This study has been carried out during the tenure of a Research Fellowship from the Hancock Foundation and a Fulbright Research Scholarship.

Stegocephalus hancocki, new species.

(Plates 9-11)

Description of Female:

Body tumid, head small, eyes absent, rostrum not strongly developed. First body segment twice length of head, as long as 2nd and 3rd segments combined.

Antenna 1: Slightly shorter than 2nd; 2nd and 3rd peduncle segments ⅔ length 1st; flagellum slightly longer than peduncle, of 6 long segments, the 1st as long as last 2 peduncle segments; accessory flagellum of 1 cylindrical segment which is more than ½ length 1st flagellar segment.

Antenna 2: Flagellum of 7 segments, shorter than peduncle; 4th and 5th peduncle segments subequal, much longer than 3rd.

Upper Lip: Asymmetrically bilobed.

Epistome: Distinguished from upper lip only by very shallow groove.

Lower Lip: Inner lobes absent, outer lobes produced on inner margin distally in distinct short toothed process.

Mandibles: Left finely denticulate, as is accessory article; right strongly denticulate, lacks accessory.

*Allen Hancock Foundation Contribution No. 168

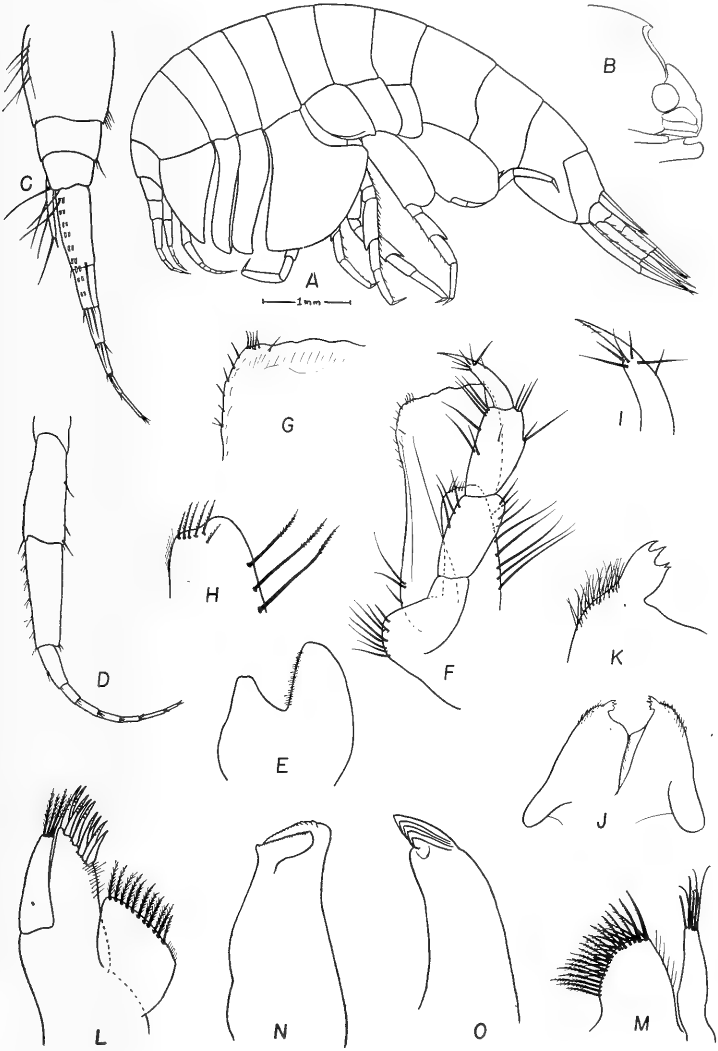

PLATE 9

Stegocephalus hancocki, n. sp. Female.

A.—Adult female. B.—Head with antennae removed to show small shallow groove separating epistome and upper lip. C.—Antenna 1. D.—Antenna 2. E.—Upper lip. F.—Maxilliped (slightly distorted). G.—Maxilliped outer plate, inner distal angle. H.—Maxilliped inner plate. I.—Maxilliped dactylos. J.—Lower lip. K.—Lower lip, distal angle. L.—Maxilla 1. M.—Maxilla 2. N.—Left mandible. O.—Right mandible.

Maxilla 1: Inner plate much shorter and broader than outer, distally truncate margin has 11 plumose setae. Outer plate has 9 spines; palp is barely shorter, is of one segment, has 4 plumose setae distally, narrows a little towards end.

Maxilla 2: Inner plate short, broad, has double row of finely plumose setae; outer apart, narrow, with about 7 spine-setae on end.

Maxilliped: Inner plate much shorter than outer, subrectangular, has about 6 fine setae distally, 7-8 long setae on inner margin. Outer plate large, somewhat subrectangular, reaches ½ along palp dactylos, has several very fine setae on inner margin distally, 4 together on angle. Last 3 segments of palp subequal; dactylos long and sharp, with fine setae about ⅔.

Gnathopod 1: Simple, sideplate subtriangular and distally acute, slightly shorter than sideplate of Gn. 2. Second segment slightly longer than next 3, 3rd and 4th subequal, 5th slightly longer, 6th still longer, 7th ½ length 6th. All strongly setose, some of setae plumose.

Gnathopod 2: Simple. Sideplate very long and narrow, greatest width ¼ length, anterodistally rounded. Basos proximally narrowed and slightly angled, as long as next 3 segments; 3rd 2/5 basos length; 4th and 5th subequal and ⅓ basos; 6th ½ basos and distally narrowing; 7th not ½ length 6th. All strongly setose posteriorly.

Peraeopod 1: Sideplate narrow, like 2nd. Third segment ¼ length 2nd; 4th ½ 2nd and slightly produced down over 5th anterodistally; 5th narrower, ⅓ 2nd; 6th as long as 4th, narrower; 7th not ½ as long as 6th; all have fine spines or setae posteriorly, a few setae anteriorly; 6th has 3 setae posteriorly.

Peraeopod 2: Similar except for sideplate which is more or less subtriangular, shallowly excavate posteriorly. Margins of all sideplates somewhat imbricated.

Peraeopod 3: Very long, longer than 4 and 5, like them except for sideplate and basos. Sideplate subsquare, fits into excavation of 2nd which partially covers it. Basos more than ½ as long again, not expanded, longer than next 3 segments; 3rd segment only about 1/6 length 2nd; 4th little more than ⅓ as long, anterodistally produced downwards a little over 5th; 5th slightly shorter than 4th, narrower; 6th almost ½ basos length, slender; dactylos ½ 6th, also slender. Segments have a few setae anteriorly, 2nd and 3rd have a few spines and setae posterodistally, 4th to 6th more strongly armed with spines and setae, some of spines having finely-combed margins.

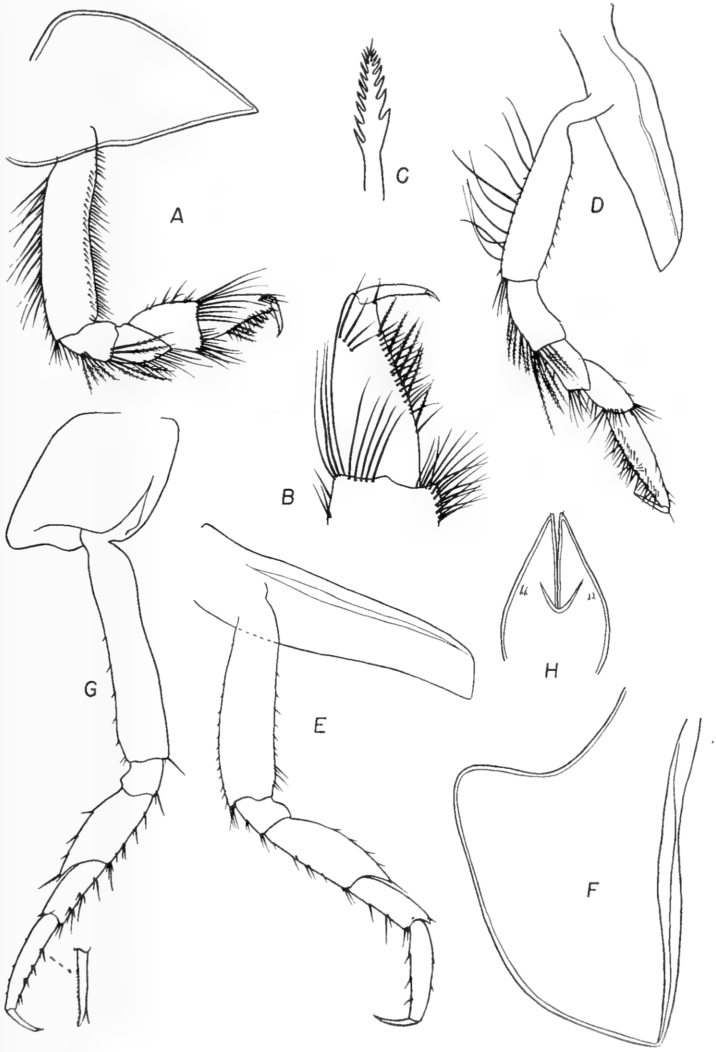

PLATE 10

PLATE 2. *Stegocephalus hancocki*, n. sp.

A.—Gnathopod 1. B.—Gnathopod 1, propod and dactylos. C.—Spine from Gnathopod 1, propod inner margin. D.—Gnathopod 2. E.—Peraeopod 1. F.—Peraeopod 2, sideplate only. G.—Peraeopod 3, with enlarged propod spine. H.—Telson.

PERAEOPOD 4: Sideplate subrectangular, width ¾ length; length ¾ basos; basos ovate-rectangular, lateral margins more or less parallel and almost naked, width little more than ½ length. Otherwise like pr. 3.

PERAEOPOD 5: Sideplate subrectangular, not quite as wide as long; ½ basos length; basos expanded ovately, width approaching ⅔ length, much longer than sideplate, anterior margin has a few short spines; posterior is finely serrate with very fine setae; posterodistally produced more than ½ along 4th segment in rounded lobe with only slightest suggestion of an acute angle. More strongly spined and setose anteriorly than pr. 3.

PLEON SEGMENTS: Dorsally normal; keel absent. First epimeral plate subtriangular with about 4 short spines anteriorly. Second subrectangular, anterior angle rounded, about 6 spine-setae anteroventrally. Third subrectangular, wider than deep; ventral margin has several spine-setae anteriorly; posterior margin is oblique and widest distally; posterodistal angle rounded with about 9 serrations on rounded angle, a minute seta to each serration.

UROPODS: Successively shorter. First, rami subequal, about ¾ peduncle length, about 2 and 7 spines on dorsal margins which are finely denticulate; peduncle is strongly spined on ventral margin and both dorsal margins. Second, rami slightly longer than peduncle, inner slightly longer than outer; 3 and 2 spines on one, about 6 on other, the margins finely denticulate; the peduncle margins with 14 and 3 spines. Third, rami lanceolate, inner longer than outer, outer longer than peduncle; 1 and 3 spines, possibly more, on rami; none on peduncle; rami margins finely denticulate.

TELSON: Cleft between ½ and ⅔, subtriangular, 2 fine setae on surface of each lobe just above end of cleft. Reaches ½ along uropod 3 peduncle.

MALE: Unknown.

TYPE: Holotype slide, AHF No. 4113, female, length 5½ mm., depth 2¾ mm., width 1¾ mm.

TYPE LOCALITY: Station 1223-41, San Pedro Channel, 12 mi. SW of Newport, in area 33° 27′ 00″ — 33° 27′ 20″N, 118° 02′ 20″ — 118° 02′ 35″W, depth 225 to 250 fathoms, bottom green sand and mud. Jan. 25, 1941.

MATERIAL EXAMINED: The type.

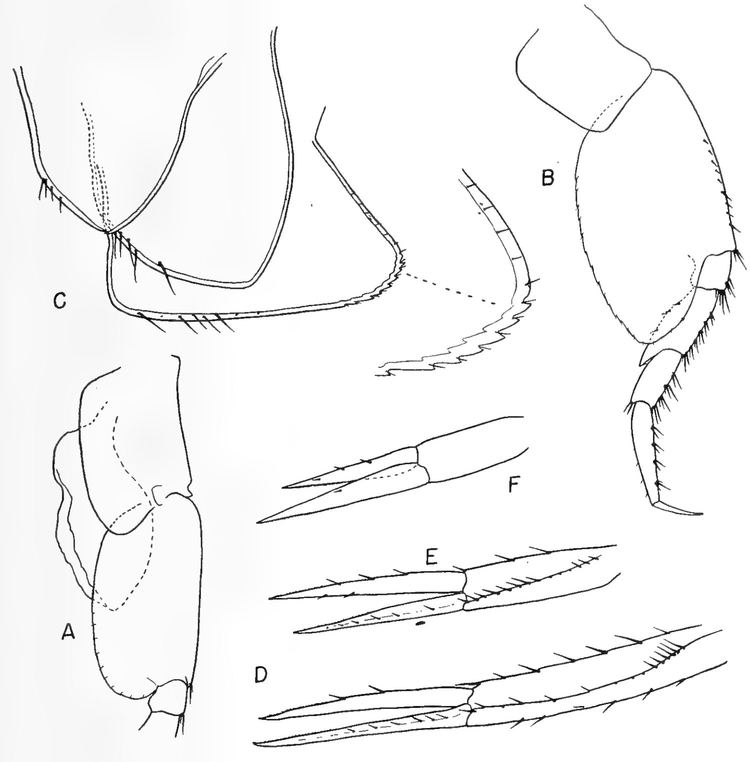

PLATE 11

Stegocephalus hancocki, n. sp.

A.—Peraeopod 4, anterior segments. B.—Peraeopod 5. C.—Epimeral plates with enlargement of distal angle of 3rd. D.—Uropod 1. E.—Uropod 2. F.—Uropod 3.

REMARKS: Although close to *Stegocephalus inflatus* Kroyer, the following differences may be noted. The third epimeral plate in *S. inflatus* is ventrally serrate with the posterodistal angle sharp and even slightly produced posteriorly; here it is rounded and serrate. *S. inflatus* is more strongly spined on the inner plate of

the 1st maxillae and the maxilliped palps. There are fewer and longer flagellar segments to the antennae of S. *hancocki;* the 2nd peraeopod sideplate is distinct in shape; and the 2nd segments of the 4th and 5th peraeopods round posterodistally. The spination of the uropods, especially that of the 3rd, differs from S. *inflatus* as figured by Sars.

Whilst most of these points could possibly fall within the normal range of variation in S. *inflatus*, the shape of the 3rd epimeral plate and, to a lesser extent, that of the 4th and 5th peraeopods adequately distinguish this species.

It gives me considerable pleasure to name this species for Captain Allan Hancock.

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TWO RARE AMPHIPODS FROM CALIFORNIA WITH NOTES ON THE GENUS *ATYLUS**

By J. Laurens Barnard

Dept. of Biology, University of Southern California

A small collection of gammaridean amphipods made by Mr. W. K. Emerson and the writer at Albion, California, during the summer of 1949, revealed the presence of a species new to science and a rare species, not reported on since 1871.

The writer is indebted to the staff of the Allan Hancock Foundation for support and equipment and to Mr. H. W. Clark of Pacific Union College for use of facilities at the Mendocino Biological Field Station, Albion, California.

Family PLEUSTIDAE

Parapleustes bairdi (Boeck)

(Plate 12)

Paramphitoë Bairdi Boeck 1871, pp. 45-46, 50, pl. 1, fig. 3.
Neopleustes bairdi, Stebbing 1906, vol. 21, pp. 314-315.

Description of male.—Lateral lobes of head asymmetrically produced, rostrum blunt, short. Eyes nearly round, large.

Antenna 1 longer than 2, almost three-fifths the length of the animal, articles of peduncle successively shorter, flagellum with about 36 articles, alternately armed with aesthetascs. Accessory flagellum rudimentary.

Antenna 2: article 5 of peduncle longer than 4, flagellum with about 28 articles.

Mandible: molar weak, rather narrow, spine row with about 15 spines, accessory plate well developed in left mandible, absent in right; article 3 of palp slightly longer than 2.

Maxilla 1: inner plate with a single, apical seta, outer plate with 9 spines, article 2 of palp apex armed with 7 spinules and several setae.

Maxilla 2: inner edge of inner plate with a strong seta, apices of both lobes setose.

Maxilliped: inner plate reaching to base of palp article 1, apex broadly truncated, armed medially with 4 or 5 short, peg-shaped spinules, laterally with 2 setae, outer plate reaching beyond end of palp article 1, armed on inner edge and apex with

* Contribution no. 106 from the Allan Hancock Foundation.

short setae. Palp typical, stout, lacking any coniform projection on article 3.

Gnathopod 1: lower posterior corner of coxa with a small tooth, posterior edge with a single spine, anterodistal end of article 2 produced downward, article 3 produced anteriorly, article 4 as long as 5, distal posterior end with a tooth, article 5 produced into a posterior setose lobe; article 6 large, palm oblique, convex, with an ill-defined, narrow tooth about one third of the distance from the finger hinge, palm lined with spinules, defined posteriorly by 2 groups of spines and a fascicle of setae; article 7 long, curved, fitting palm.

Gnathopod 2 slightly larger than 1, identical except for the shape of the coxa and the presence of 3 spines on its posterior edge.

Peraeopod 1 longer than 2, coxa 3 with a tooth and 3 spines, coxa 4 without tooth or spines.

Peraeopods 3-5 successively slightly longer, similar, posterior edges of second articles minutely serrated.

Pleopods with 2 cleft spines on first article of inner ramus.

Uropods extending the same distance posteriorward, rami strongly spinulated, apices of rami of first 2 pairs armed with spines.

Uropod 1: inner ramus shorter than peduncle, outer ramus slightly shorter than inner.

Uropod 2: inner ramus much longer than peduncle, outer ramus three fourths as long as inner.

Uropod 3: inner ramus twice as long as peduncle, outer ramus two thirds as long as inner, apices of rami unarmed.

Telson linguiform.

Body segments smooth, not carinated. Pleon segment 3: posterior edge of epimera slightly convex, lower posterior corner quadrate, slightly produced.

Material examined.—A single male, 5.5 mm. in length, Emerson-Barnard Station No. 26, Cormorant Cove, Albion Bay, algae at water level, minus 0.9 tide, June 30, 1949.

Remarks.—This is the second record of this species, Boeck recording it from San Francisco, California, in 1871. It differs from *Parapleustes assimilis* (Sars) by the strongly developed hands of the gnathopods. From *Parapleustes gracilis* Buchholz it differs by the shape of the telson and the larger gnathopods. Sexton (1909, pp. 852-855, pl. 80, figs. 1-7) redescribed one of

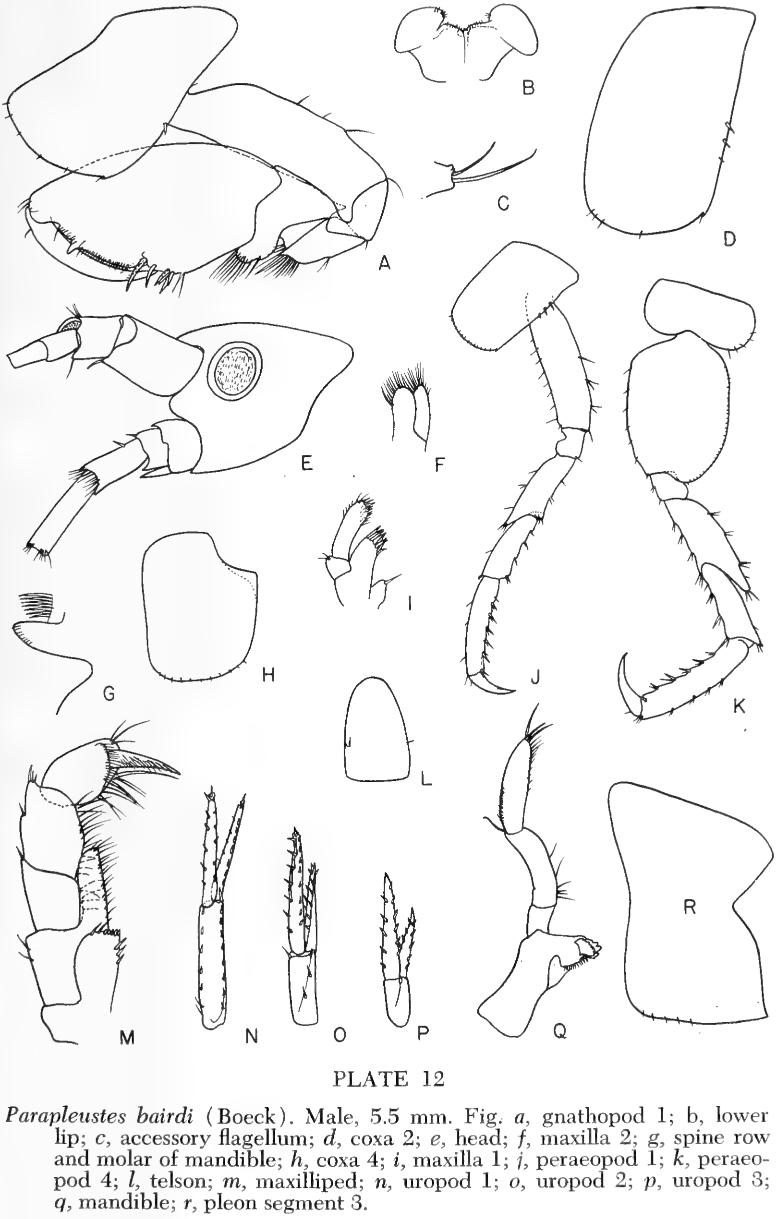

PLATE 12

Parapleustes bairdi (Boeck). Male, 5.5 mm. Fig. *a*, gnathopod 1; b, lower lip; *c*, accessory flagellum; *d*, coxa 2; *e*, head; *f*, maxilla 2; *g*, spine row and molar of mandible; *h*, coxa 4; *i*, maxilla 1; *j*, peraeopod 1; *k*, peraeopod 4; *l*, telson; *m*, maxilliped; *n*, uropod 1; *o*, uropod 2; *p*, uropod 3; *q*, mandible; *r*, pleon segment 3.

Buchholz' type specimens of *P. gracilis* and also had the type specimens of "*Paramphithoë brevicornis* Sars." She compared them and found they were alike except for the fact that in Sars' material the first antennae were shorter and the second article of the peduncle of antenna 1 was as long as article 1. Sexton attributed these differences to age. The present single specimen differs from Sexton's description of *P. gracilis* by the short second article of antenna 1 peduncle, by the more numerous articles of the antennal flagella, by the greater number of spines in the spine row of the mandible (more than double the number) and by the apical armature of the inner plate of the maxilliped (which in Sexton's figures had 2 small teeth and 2 setae). From *Paramphitoë brevicornis* Sars the present specimen differs by the larger gnathopods, by the shape of the telson and by the longer antennae. Sexton stated that the telson of *P. gracilis* was similar to that figured by Sars for *P. brevicornis* (in which the lateral apical edges are beveled).

Because the present specimen is a male (while all observations on *P. gracilis* have been on females) it is possible that it might belong to that species. However, the mouthpart armature is better developed than in Sexton's material and the flagellar articles are more numerous, indicating the specimen is more mature. If so, the short second peduncular article of antenna 1 is unlike adult *P. gracilis* and this would be a valid difference.

Neopleustes derzhavini Gurjanova (1938, p. 317) is very close to *P. bairdi*, a particular point of resemblance being the small conical processes on the palms of the gnathopods. However, the sixth articles are smaller than the respective coxae while in P. *bairdi* they are as large or larger. In gnathopod size, *N. derzhavini* resembles *P. pugettensis* (Dana), see Barnard, 1952, p. 12. It is possible that *Parapleustes gracilis* is a synonym of *P. pugettensis* but comparative materials will be needed to decide this question.

Family ATYLIDAE

Genus *ATYLUS* Leach, new synonymy

Atylus Leach 1815, Zool. Misc., vol. 2, p. 21.
Nototropis Costa 1853, Rend. Soc. Reale Borbonica, n. s., vol. 2, pp. 170, 173.

Atylus levidensus new species

(Plates 13-14)

Description of male.—Head about as long as first 3 body segments (including rostrum), rostrum well developed, subacute, lateral lobes of head subacutely produced, eyes small, oval.

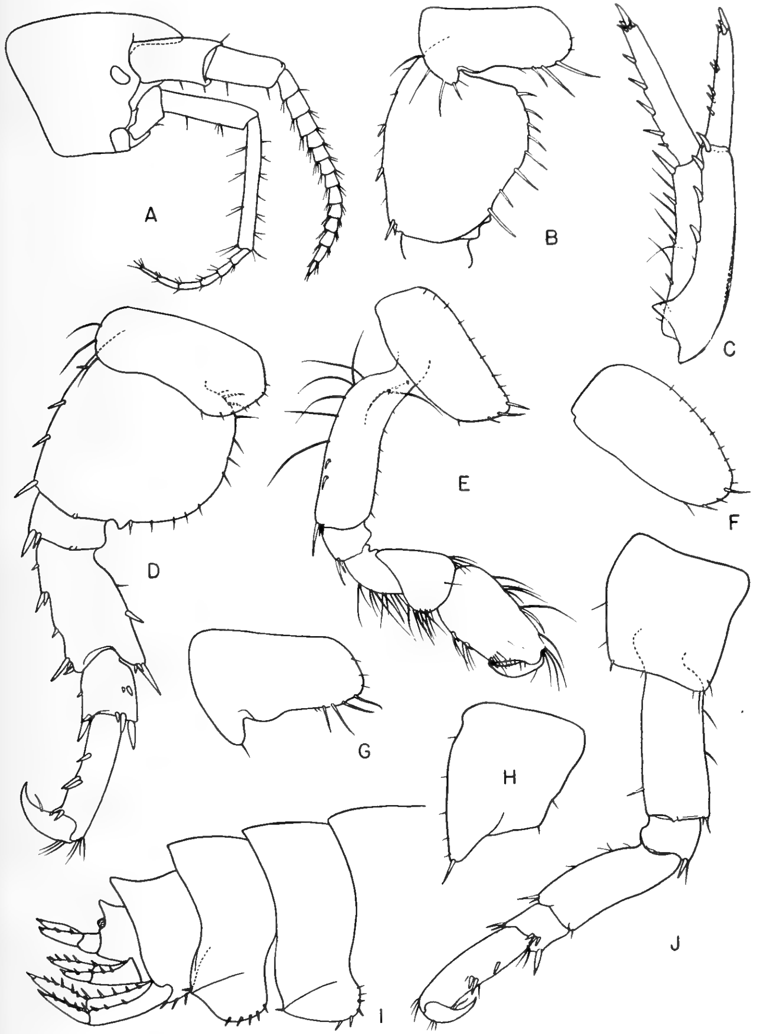

PLATE 13

Atylus levidensus, n. sp. Male, 6.5 mm. Fig. *a,* head; *b,* peraeopod 4, part; *c,* uropod 1; *d,* peraeopod 5; *e,* gnathopod 1; *f,* coxa 2; *g,* coxa 5; *h,* coxa 3; *i,* pleon segments 2-6, telson not shown; *j,* peraeopod 2.

Both pairs of antennae reaching about the same length, short, article 1 slightly longer than 2, article 3 short, not longer than 2 basal segments of flagellum. Flagellum about as long as peduncle, composed of 12 articles and a small apical rudiment, accessory flagellum rudimentary.

Antenna 2: article 5 longer than 4, flagellum about as long as article 5, composed of 6 articles and a small apical rudiment.

Upper lip evenly rounded below.

Mandible: molar moderately well developed, accessory plate strong, spine row with 9 echinulate spines; palp slender, article 3 longer than 2, with 3 setae at apex of article 3, otherwise without setae.

Lower lip without inner lobes.

Maxilla 1: inner plate with oblique apex, armed with 3 setae, outer plate with 10 spines, article 2 of palp apex armed with 5 spines, the spines stout on right palp, slender on left palp, apex of palp produced into acute tooth at outer edge, medial to the outermost spine.

Maxilla 2 with a strong, plumose seta on inner edge of inner plate; outer plate much broader than inner.

Maxilliped: apex of inner plate truncated, armed with 3 stout spines and 5-6 setae; outer plate reaching to end of palp article 2, inner edge and apex lined with stout spines; palp slender, article 4 produced into a spine apically.

Gnathopod 1: article 6 longer than 5, not tumid, palm oblique, defined by a pair of spines, article 7 fitting palm.

Gnathopod 2 slightly longer than 1, article 6 longer than 5, longer and more slender than in gnathopod 1.

Peraeopods 1 and 2 equal in size. Peraeopod 1, coxa produced anteriorly and downward into an acute lobe, articles 3 and 5 short, subequal in length, articles 4 and 6 long, equal in length. Peraeopod 2: coxa trapezoidal in outline.

Peraeopods 3 and 5 similar in structure except that peraeopod 3 is shorter and article 2 is not expanded as in peraeopod 5. Peraeopod 4 longer than 5, article 4 elongated, as long as articles 4 and 5 of peraeopod 5 combined.

All gills simple, not pleated.

Uropod 1 reaching beyond uropods 2 and 3, inner ramus longer than outer, nearly as long as peduncle.

Uropod 2: inner ramus longer than peduncle, longer than outer ramus.

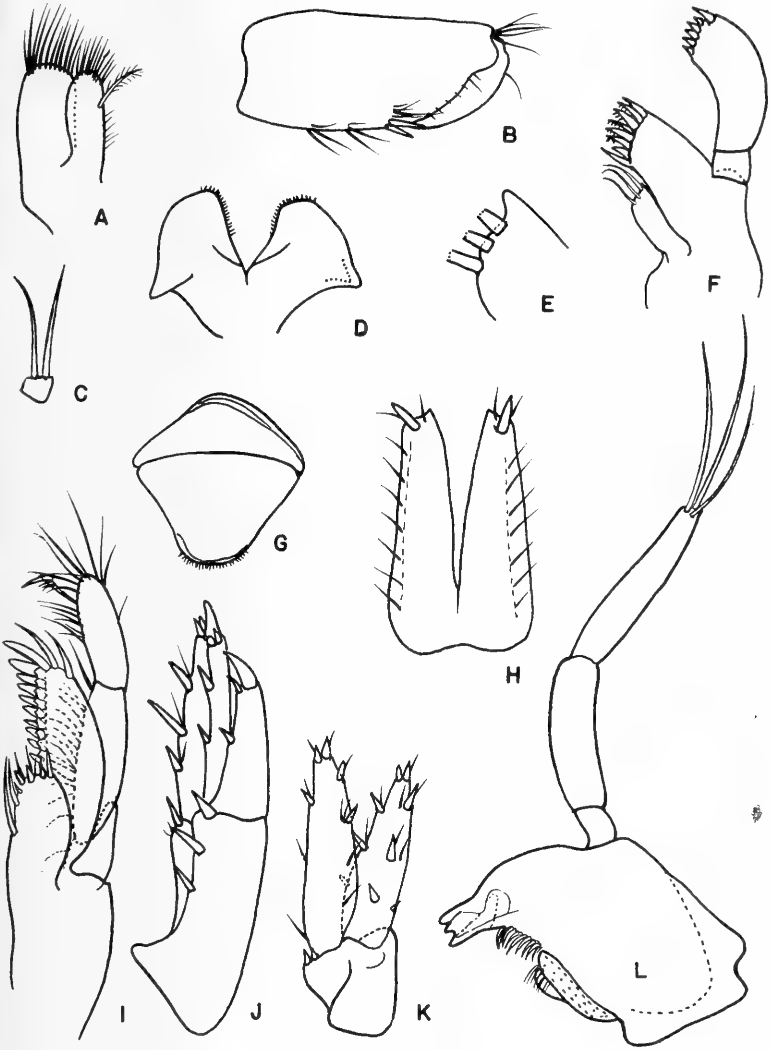

PLATE 14

Atylus levidensus, n. sp. Male, 6.5 mm. Fig. *a,* maxilla 2; *b,* end of gnathopod 2; *c,* accessory flagellum; *d,* lower lip; *e,* inner plate, maxilla 1, part; *f,* maxilla 1; *g,* upper lip; *h,* telson; *i,* maxilliped; *j,* uropod 2; *k,* uropod 3; *l,* mandible.

Uropod 3: rami short, stout, lanceolate.

Telson slender, deeply cleft, apices obliquely truncated, each armed with a stout spine and a setule.

All pleon segments carinate middorsally, each ending acutely above the following segment, segments 5-6 (fused) with a strong, upturned tooth. Pleon segment 3: inferoposterior angle of epimera slightly produced, armed with a spine, the anterior part of the lower edge produced downward strongly, rounded, armed with spinules.

Peraeon segments slightly carinate middorsally, not ending acutely above following segments.

FEMALE.—Not known.

HOLOTYPE.—AHF No. 4916, 7.5 mm. in length, male.

TYPE LOCALITY.—Puget Sound, August 9, 1949, coll. Dr. J. L. Mohr.

MATERIAL EXAMINED.—The type and one male specimen, 6.5 mm. long from Emerson-Barnard Station No. 11, Salmon Point, California, south of Albion Bay, tide pool, minus 1.3 tide, June 13, 1949.

REMARKS.—This species differs in several respects from the type species of the genus, *Atylus carinatus* (Fabricius): (1), the slender and poorly setose third palp article of the mandible; (2), the poorly setose inner plate of maxilla 1; (3), the short rami of uropod 3. Easily visible differences of the new species are the following: (4), lack of well defined carinae on the peraeon segments; (5), the sharp tooth or carina on pleon segments 5-6; (6), the shape of pleon segment 3, epimera; (7), shape of third coxa.

This species appears to be rather rare in the California, Oregon and Washington intertidal. The writer has examined several score samples from these areas with a yield of only 2 specimens.

REMARKS ON THE GENERA *ATYLUS* AND *NOTOTROPIS*

It would appear that the new species described herein is more closely related to *Nototropis collingi* Gurjanova (1938, p. 328) by virtue of its short third uropods and slight mandibular palp than to *Atylus carinatus*. Stebbing (1906, p. 328) distinguished the two genera by the strong mandibular palp and dorsally unnotched fourth pleonal segment of *Atylus*. *Nototropis collingi* has a poorly notched fourth pleonal segment compared to other species of *Nototropis* and *Atylus levidensus* n. sp. lacks this notch. Gurjanova (1951, p. 678) distinguished *Atylus* from *Nototropis* additionally by the simple, unpleated gills on all seg-

ments while in the latter some gills are strongly pleated. The new species herein combines a slight mandibular palp, an unnotched fourth pleonal segment and unpleated gills, thus transcending criteria used to separte the two genera. The close relationship of the new atylid with *N. collingi*, a *Nototropis* by definition, as well as the monotypic condition of the genus *Atylus* leads the writer to believe that the two genera should be fused. Although the notching of pleonal segment 4 still might be used for separation, the writer believes that ornamentation of this type has no value for generic distinction. One need only compare the various expressions of dorsal ornamentation in the genus *Nototropis*, or in *Parapleustes* the previously discussed genus, to see that such a minor character as the presence or absence of a notch is valueless. The same statement applies to the variation in the gills which may be regarded as adaptive features which rarely indicate broadly diverging lines of evolution.

The writer favors the fusion of the genera *Atylus* and *Nototropis* with the former having priority.

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A NEW SPECIES OF AMNICOLID SNAIL FROM CHIHUAHUA, MEXICO

By ROBERT J. DRAKE

Department of Zoology, University of Arizona

(Some results of research with inland mollusks of Northwest Mexico financed by the Penrose Fund of The American Philosophical Society)

The desert region in the northern part of the Mexican states of Chihuahua and Sonora south of New Mexico and Arizona in the United States has a small number of forms of the Amnicolidae living in isolated springs and temporary pond habitats. Undoubtedly these very small snails represent part of a relict aquatic fauna formerly more extensive and populous (see Pilsbry 1895, 1928, 1935; Pilsbry and Ferriss 1906, 1909; Smith 1953).

Discussion of the region where the present new species was discovered and circumstances of its collection has been given previously (Drake 1953). Drs. Harald A. Rehder and Joseph P. E. Morrison of the U. S. National Museum, Dr. Leo G. Hertlein and Mr. Allyn G. Smith of the California Academy of Sciences, and Dr. Wendell O. Gregg of Los Angeles, California, were very helpful to study of the undescribed form which is named in honor of an advisor and associate of nineteen years. Mrs. Margaret M. Hanna kindly made the drawing of the holotype.

Lyrodes hertleini, new species

(Plate 15)

DIAGNOSIS: An amnicolid species that seems most nearly related conchologically to those forms described as *Paludestrina diaboli* Pilsbry and Ferriss (1906: 170, fig. 36) from New Mexico Pleistocene or Recent alluvium and *Potamopyrgus cheatumi* Pilsbry (1935: 91, fig. 4) living in Texas. *Cheatumi* has 5½ whorls and is near 1.75 mm. high and *diaboli* has 4½ whorls and is smaller than *L. hertleini* being around 1.30 mm. high. The 4¾ whorls of *hertleini* are not as convex as those of *diaboli*. Another amnicolid living in 1949 with *Lyrodes hertleini* at the type locality, *Amnicola brandi* Drake (1953), is far more globose and has nearly one whorl less than *hertleini*.

HOLOTYPE: Length, 2.48 mm.; major diameter, 1.96 mm.; height of aperture, 1.02 mm.; width of aperture, 0.83 mm. Aperture ovate, slightly rimmed, a bit oblique, contained in the

PLATE 15

Lyrodes hertleini Drake Holotype

total shell about 2½ times for height and less than half for width, generally adnate. Color, yellowish chalky-white with an olive stain. Protoconch slightly eroded, almost flat, not depressed. Whorls, 4¾, quite convex, deep suture, no sculpture other than faint growth lines; body whorl projects at bottom and on the right when viewed from the front. Umbilicus narrow, barely visible through chink in callus. Columella slender, has no processes. Shell shape: not acutely pointed, not globose, not slender. No. 9982 in the Department of Paleontology Type Collection, California Academy of Sciences (Golden Gate Park, San Francisco, California). Type material collected by Dr. C. Clayton Hoff and R. J. Drake, 15 April 1949, from springs at Las Palomas, Chihuahua, Mexico.

PARATYPES: California Academy of Sciences Department of Paleontology Type Collection, Nos. 9983-9987; British Museum (Natural History), Nos. 1955.9.22.10-13; U. S. National Museum Division of Mollusks, No. 600498; Chicago Natural History Museum, No. 53877; Museum of Comparative Zoölogy, No. 186777; San Diego Museum of Natural History, No. 13218; University of California Museum of Paleontology, Nos. 34813a-d; University of Arizona Invertebrate Museum, No. 101; Wendell O. Gregg Collection, No. 7218.

Notes: Placement of *hertleini* in the genus followed the helpful suggestion of Dr. Joseph P. E. Morrison who examined reproductive anatomy in preserved animals of paratypes deposited in the U. S. National Museum. The operculum was not later available for inclusion in the description.

Still another amnicolid, of which two dead shells were collected by Maj. Mearns in 1892 (Drake 1953: 26) from the general area of the type localities of *L. hertleini* and *A. brandi,* and described as *Bythinella palomasensis* Pilsbry (1895: 68-69) perhaps may be either a *Durangonella* or a *Lyrodes*—as to be determined sometime by malacological investigation and if fresh specimens are eventually available.

Malacological comparison of *Potamopyrgus* Stimpson and *Lyrodes* Doering after examination of dried-in animals was given by Morrison (1939).

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FISH RECORDS FROM THE PLEISTOCENE OF SOUTHERN CALIFORNIA

In the Collections of the Los Angeles County Museum

By GEORGE P. KANAKOFF

The following species of fish were kindly determined for the Los Angeles County Museum by Mr. John E. Fitch, Assistant Director of California State Fisheries Laboratory, Terminal Island, from Pleistocene fossils recovered in Los Angeles and Orange Counties, California. Comparisons were made with skeletal remains of living forms. No extinct forms were found. Locality numbers refer to the museum's fossil localities in Invertebrate Paleontology, as follows:

LACMIP 58

Lower Pleistocene (San Pedro sand) stratum, 150 feet above sea level, about 10 feet thick, in the real estate subdivision of the Capistrano Beach Palisades, Orange County, California.

LACMIP 59

Known locally as "Lincoln Avenue deposit"; see Willett, George, 1937, "An Upper Pleistocene Fauna from Baldwin Hills, Los Angeles County, California," San Diego Soc. Nat. Hist., v. 8, No. 30, pp. 379-406, 2 pls.

LACMIP 66-2

An exposure of Upper Pleistocene (Palos Verdes sand) 100 feet above the present high tide level, and about ¼ mile back from water's edge, at the east end of the Newport Bay Estuary, ⅛ of a mile SW from the salt-reducing plant of the Irvine Estate, Newport Bay Mesa, Orange County, California.

LACMIP 68-B

An exposure of Upper Pleistocene (Palos Verdes sand), about 90 feet above the present high tide level in the vertical cliff on the west bank of the Newport Bay Estuary, Costa Mesa, Orange County, California.

LACMIP 131

Lower Pleistocene (San Pedro sand) exposure in the 500 block of North Pacific Blvd., San Pedro, Los Angeles County, California.

The species are enumerated in biological order, with their common names, families, and the present range of geographical distribution.

CODE:

1-0 (1 Otolith)
1-D (1 piece of dentition)
1-Sp. (1 dorsal spine)
1-0s (1 opercular spine)
1-St (1 sting)

Species: Laemip Localities	Lower Pleistocene		Upper Pleistocene		
	58	131	59	66-2	68-B
Heterodontus francisci (Girard) "Horn Shark" f. Heterodontidae (Monterey Bay, Calif. to Guaymas, Mex.)				4-Sp	
Notorynchus maculatum Ayres "Sevengill Shark" f. Hexanchidae (Northern British Columbia to San Diego)	3-D		8-D		
Lamna ditropis Hubbs and Follett "Salmon Shark" f. Lamnidae (Japan and Alaska to Southern Calif.)				5-D	
Isurus glaucus (Müller and Henle) "Bonito Shark" f. Lamnidae (Japan; Pacific to Magdalena Bay, Baja Calif., West Mexico)		1-D	3-D	13-D	
Carcharodon carcharias (L) "Man-eater" f. Lamnidae (Temperate and tropical water of Atlantic and Pacific) (San Diego to Monterey Bay)			5-D	3-D	
Cetorhinus maximus (Gunner) "Basking Shark" f. Cetorhinidae in Atlantic and Pacific (Baja Calif. to Alaska)				1-D	
Triakis semifasciata Girard "Leopard Shark" f. Triakidae (Oregon to Magdalena Bay, Baja Calif.)			7-D	1-D	
Carcharhinus lamiella (Jordan & Gilbert) "Bay Shark" f. Carcharhinidae (Southern Calif. to Mazatlan)			23-D	57-D	12-D
Prionace glauca (L.) "Blue Shark" f. Carcharhinidae Tropical and temperate waters of the world. Pelagic (British Columbia to Gulf of Calif.)			8-D	1-D	
Sphyrna zygaena (L.) "Hammerhead Shark" f. Sphyrnidae Tropical and warm temperate seas of the world (North to Southern Calif.)			4-D	1-D	
Urobatis halleri (Cooper) "Round Stingray" f. Dasyatidae (Pt. Conception to Panama)		3-St	138-St	35-St	
Myliobatis californicus (Gill) "Bat ray" f. Myliobatidae (Oregon to San Felipe and Gulf of Calif.)		160-D	3-St	3-St	
Merluccius productus (Ayres) "Californian Hake" f. Merlucciidae Alaska to Magdalena Bay			2.0		
Paralichthys californicus (Ayres) "Calif. Halibut" f. Bothidae Bodega Bay, Calif. to Magdalena Bay, Baja Calif.			1-0		
Anisotremus davidsoni (Steindachner) "Sargo" f. Haemulidae Pt. Conception to Guaymas, Mex.			1-0		
Cynoscion nobilis (Ayres) "White Seabass" f. Sciaenidae Alaska to Gulf of Calif. (San Felipe)			4-0		

Species: Lacmip Localities	Lower Pleistocene		Upper Pleistocene		
	58	131	59	66-2	68-B
Seriphus politus Ayres "Queenfish" f. Sciaenidae Monterey Bay to San Juanico Bay, Baja Calif.			81-0	3-0	
Micropogon ectenes Jordan & Gilbert f. Sciaenidae Berrugato, Magdalena Bay, Baja Calif. to Mazatlan, W. Mexico			2-0		
Genyonemus lineatus (Ayres) "Kingfish" or "White Croaker" f. Sciaenidae Vancouver Island to San Juanico Bay, Baja Calif.		1-0	61-0		
Roncador stearnsi (Steindachner) "Spotfin Croaker" f. Sciaenidae Pt. Conception to San Juanico Bay, Baja Calif.			5-0		
Umbrina roncador Jordan & Gilbert "Yellowfin Croaker" f. Sciaenidae Pt. Conception to Magdalena Bay, Baja Calif.		1-0			
Pimelometopon pulchrum (Ayres) "Calif. Sheephead" f. Labridae Monterey Bay to Gulf of Calif. (La Paz)				2-0 17-D	
Sebastodes sp. (3 species undetermined) "Rockfish" f. Scorpaenidae Alaska (Japan) to Gulf of Calif.		4-0	2-0		
Leptocottus armatus Girard "Staghorn Sculpin" f. Cottidae Alaska to San Quentin Bay, Baja Calif.			1-0	1-0s	
Parichthys myriaster Hubbs & Schultz "Slim Midshipman," f. Batrachoididae Morro Bay to Cedros Is.					
Otophidium scrippsae Hubbs "Calif. Cusk-eel" f. Ophidiidae Point Arguello, Calif. to Cerros Id., Baja Calif.			16-0	1-0	
Otophidium taylori Girard "Spotted Cusk-eel" f. Ophidiidae San Francisco into Baja Calif.			5-0	1-0	

Of the above species of fish, three are considered strictly northern in distribution today: **Notorynchus maculatum, Lamna ditropis,** and **Cetorhinus maximum;** and three are of the Panamic fauna: **Carcharhinus lamiella, Sphyrna zygaena,** and **Micropogon ectenes.**

Footnote: Since the above list was submitted for publication three specimens of fish (one of which represents an additional species), from two additional localities, have been found among molluscan remains in old collections: **Dasyatis dipterurus** (Jordan & Gilbert), f. Dasyatidae, present distribution British Columbia to Magdalena Bay; 2-St from LACMIP locality no. 77, a 30-ft deep trench dug for installation of outfall sewer at Main and Lomita, Wilmington, Calif., and exposed for only two days; Upper Pleistocene. **Lamna ditropis** Hubbs & Follett, f. Lamnidae, present distribution Japan and Alaska to southern California, 1-D; LACMIP locality no. 130-7, a 30-ft bluff exposed at the type locality for the Timms Point formation, opposite "Fisherman's Slip" in San Pedro harbor, testhole no. 7 at extreme south of bluff; Lower Pleistocene.

LAURENA MOORE ALLIOT

1869 - 1955

Laurena Moore Alliot, a life member of the Southern California Academy of Sciences, passed away in Los Angeles on May 4, 1955.

Mrs. Alliot was the widow of Hector Alliot, a former Trustee, and President of this Academy. She was born in Barnesville, County of Belmont, Ohio, January 12, 1869, daughter of Eli Moore and Laura Alverda Dove (Moore).

Although Mrs. Alliot did not take an active part in the affairs of our Academy to the extent that she did in the Ruskin Art Club, she was always ready to lend her influence, and to cooperate in every possible manner. A fitting tribute to her, and a record of her activities as a Ruskin Art Club member was published in the Southwest Museum's "Masterkey" of July-August, 1955, which mentions the fact that she was listed at the time of her death as the only Honorary Member of that Club, and the author of its history, under the title of "Sixty Years in Retrospect."

Among her other activities, it has been determined that she was a member of the Daughters of the American Revolution.

The Board of Trustees of the Southern California Academy of Sciences voted to establish a memorial fund in the name of Laurena Moore Alliot, and has transferred an initial sum to its endowment accounts for that purpose. This furnishes the medium through which her name can be kept on record in the annals of science, through the cooperation of her many friends, much as is the case with the memorial to her husband, namely, the Hector Alliot Memorial Library, established in 1919 by the Ruskin Art. Club.

J.A.C.

SCIENTIFIC NOTES

A SECOND RECORD OF *TADARIDA MOLOSSA* FROM ARIZONA

(Chiroptera, Molossidae)

The occurrence of the large free-tail bat, *Tadarida molossa* (Pallas), in Arizona has only been reported on one previous occasion (Shamel, H. H., Proc. U. S. Nat. Mus. 78 (19), 1931:1-27).

A second specimen of this bat was obtained in Arizona on August 29. 1946. Because of the paucity of Arizona records and the circumstances surrounding the capture of this specimen it is felt that it is worthy of record.

On the above date, Mr. Arthur F. Sylvester of Tucson, Arizona, and Mr. Lloyd Martin, entomologist on the staff of the Los Angeles Museum, were collecting insect material in Madera Canyon, Santa Rita Mountains, Pima County. Mr. Sylvester observed a live bat entangled in the thorns of a mesquite bush (*Prosopis glandulosa*), near the mouth of the canyon at an elevation of 4400 feet. The bat was approximately five feet above ground level. Mr. Martin collected the specimen and returned with it to camp, where it died the following day. The specimen was preserved and is now number 8342 in the mammal collection of the Los Angeles County Museum. Measurements of the specimen are as follows: total length 127 mm., tail 52.0 mm., hind foot 11.0 mm., ear 21.5 mm., radius 59.0 mm., and tibia 17.0 mm.

Instances of bats becoming impaled or trapped by thorny bushes while in flight have been reported previously (Stager, K. E., Jour. Mamm., 24 (3) 1943, p. 396), but are uncommon enough to warrant recording.—KENNETH E. STAGER, *Los Angeles County Museum, Los Angeles, California.*

IS THIS A NEW, AND GIANT CLOTHES MOTH?

It has recently been called to our attention by Mr. Fred Thorne, of the San Diego County Department of Agriculture, that larvae of *Litoprosopus coachella* Hill have been taken in buildings, feeding on fabrics and paper.

If the occurrence represents a newly acquired feeding habit of this caterpillar, it might pose a serious threat to the American wardrobe.

This larva normally feeds on the reticulated or crosshatched fibers at the base of stems of the California Fan Palm (*Washingtonia filifera* Wendl.). The moth was at one time considered to be one of the rarest phalaenid species in California, and was regarded as being limited in range to the Coachella Valley.

It was first described by Charles A. Hill, then of Glendale, from two examples captured by "H. Place," (Enrico Piazza) at Palm Springs, California, and was published in the Entomological News, Vol. 32, p. 105, 1921, without an illustration.

The first picture of it appeared in the Bulletin, Southern California Academy of Sciences, Vol. 23, p. 182, fig. 10, 1924.

The writer first reported its occurrence in Los Angeles in 1933, described its life cycle, and illustrated the egg, larva, and pupa, in the Bulletin. S. C. A. S., Vol. 32, pp. 117-120.

The moth measures about 1¼ inches from tip to tip of the forewings, and the larva, when fully grown averages 1½ inches long. It is therefore a giant as compared to the common varieties of clothes moths.

The palm fibers on which the larva normally feeds are, of course, dead vegetable tissue, as is also cotton, flax, and wood fiber from which many papers are made. These types of fiber are not eaten by clothes moths, unless they happen to have grease spilled on them. Their regular diet is wool, which contains lanolin, a type of fat essential to their digestive mechanism.

It would be interesting to learn from entomologists in the field, the exact types of fabric that are eaten by the larva of *Litoprosopus coachella.*

Mr. Thorne reports that in all cases of this type thus far investigated, there were California Fan Palms growing in close proximity to the buildings. With this fact in mind, it may be presumed that a transitory population increase has caused a larval migration, which would not occur under normal conditions. It would be well, however, to keep the situation under surveillance.

Subsequent to the receipt of the above data, Mr. Thorne secured additional information from George T. Okumura, Systematic Entomologist of the Bureau of Entomology, State Department of Agriculture, Sacramento, California, which sheds new light on the range, and larval habits of *Litoprosopus coachella.* Liberal quotation from this letter is worthy of record.

"According to our records this pest has been found in the following locations: Bakersfield, Kern County; San Bernardino, San Bernardino County; Los Angeles, Los Angeles County; Riverside, Riverside County; and Palm Springs, Riverside County. These larvae were collected in the months of June, July, August and September."

"The following excerpt from an article by Mr. D. J. Ott may be of interest to you:"

"Fan Palm Caterpillar – The second instance of damage by an incidental fabric pest was encountered recently when a coat was received from Palo Alto, California. The damage was limited to the cuff of the sleeve where the nap was removed on several large areas (½ to ¾ inch dia.), and in one case a hole was apparent through the base yarns. A chemical analysis with fibers from the sleeve revealed an adequate Mitin application."

"Fortunately, the damage had been discovered by a drycleaner who then removed and saved the "moth nest" (matted cut fibers and insect refuse) before cleaning the coat. Part of this material was sent in an envelope along with the coat."

"Microscopic examination of the cut fibers did not reveal any evidence of fabric insect damage, such as typical webbing and mandible imprints. However, three small pieces of an insect larva were found: two pieces from the side of the larva and a small portion of a thoracic leg complete with tarsal claw. The appearance of these insect parts and the presence of some strands of silk in the entangled mass of cut fibers indicated the possibility of a lepidopterous larva being involved, but the insect parts in no way resembled any of the various species of clothes moths. Hence it was assumed that this was another instance of damage by an incidental fabric pest. A search through the literature revealed a description of a species that fitted this case in all respects."

"According to Flock, larvae of *Litoprosopus coachella* Hill (fan palm caterpillars) feed in the flowers and fruits of the fan palm in California, and they normally make their cocoons of the tough fibers at the base of the trees. However, they occasionally enter houses and remove the pile in large patches from rugs, draperies and other household fabrics in the process of making cocoons. Flock states further that "since the feeding and moving

about usually occur at night, the caterpillars are rarely observed. They commonly enter buildings when large numbers of mature individuals are blown from trees by wind, but a certain number fall or travel to the ground regardless of wind conditions. When on the ground the caterpillars appear to be attracted to lights so that they are likely to enter buildings before finding a suitable place to pupate."

"The above report describes caterpillars observed at Riverside, California, but Armitage *et al* state that, although this caterpillar is a native of southern and Lower California, it has followed the plantings of these common ornamental palms up into the Sacramento Valley. Subsequent to our examination of the damaged coat, an investigation in Palo Alto proved that this palm was prevalent in that area. Furthermore, the insect parts – particularly the tarsal claw – agree with the illustrations by Peterson of similar parts from other members of this same family (Phalaenidae)."

John A. Comstock

50th ANNIVERSARY OF RANCHO LA BREA FOSSIL EXCAVATIONS

March, 1956, marked the 50th anniversary of the first scientific excavations at Rancho La Brea. In March, 1906 the University of California, under the direction of Dr. John C. Merriam, sent its first field party to the site and began removing the fossil bones.

Commemorating this outstanding paleontological event, a ceremony was held on the afternoon of Sunday, March 11, at Hancock Park (the site of the Rancho La Brea fossil beds). Supervisor John Anson Ford officiated as Master of Ceremonies and Dr. Hildegarde Howard, Chief Curator of Science of the Los Angeles County Museum, presented an historical sketch of the work at the famous site in which she introduced a number of honored guests who had had contact with the early scientific work.

Representing the Southern California Academy of Sciences among these guests was Mr. Theodore Payne, member of the Academy since 1895, who has long been interested in the La Brea work. The Academy was honored for its contribution of the first skeletons of the Rancho La Brea animals to be exhibited in Los Angeles County Museum at its opening in 1913.

Special guided tours of the Park were conducted through the week of March 12-18, culminating with a talk by Dr. Theodore Downs, Curator of Vertebrate Paleontology of the Museum, following the tour on Sunday afternoon, March 18.

H. H.

LOS ANGELES MUSEUM BRAZILIAN EXPEDITION

Under the sponsorship of Mr. and Mrs. Maurice A. Machris, the Los Angeles County Museum is sending an expedition to the interior of Brazil for a 3½ month survey of the biologically unexplored headwaters of the Tocantins River. The survey will include extensive collecting of scientific specimens of birds, mammals, insects, fish, reptiles, and plants native to the region. The entire operation will be documented with color motion pictures.

Four custom built trucks with four-wheel drive, and two trailers equipped with electric power plant, refrigerators, and water purification units will be used to transport the expedition northwestward from the coast at São Paulo to the headwaters of the Tocantins. The Tocantins is one of the main tributaries of the Amazon and forms the most easterly river of the Amazon network.

The fully equipped trucks, heavy-laden with 3 months' supply of food, insect proof tents, scientific collecting equipment, etc., were shipped to Brazil from Los Angeles Harbor aboard the "S. S. Trader" of the Pope-Talbot steamship lines on Feb. 6, 1956. Expedition personnel left for Brazil by plane on March 14, 1956. Departure for the interior from São Paulo was March 28.

Personnel from Los Angeles includes Mr. and Mrs. Maurice A. Machris, Jean Delacour (Director of the Los Angeles County Museum), Harry F. Burrell (motion picture photographer), E. Yale Dawson (Botanist), Kenneth E. Stager (Ornithologist-Mammalogist), and Fred S. Truxal (Entomologist). In Rio de Janeiro, the party was joined by Antenor Carvalho (Ichthyologist-Herpetologist) from the Museu Nacional of Brazil, which is the sponsoring institution of the expedition in Brazil.

H. H.

ACADEMY PROCEEDINGS

ABSTRACT OF LECTURE ENTITLED "RIVERS OF ICE" DELIVERED BEFORE THE SOUTHERN CALIFORNIA ACADEMY OF SCIENCES, ON JANUARY 20, 1956 BY DR. ROBERT P. SHARP

Most investigations of glaciers in Alaska have been made on the lower parts of these ice bodies. Obviously the behavior of a glacier is controlled in large degree by what happens in its upper part where the substance accumulates. Fortunately, a series of expeditions (from 1948 through 1951) sponsored by the Arctic Institute of North America to the heart of the St. Elias Range, provided an opportunity for study in both the upper and lower reaches of the Seward-Malaspina Glacier system.

Any glacier consists of two principal parts, an accumulation area where it is nourished, and a wastage area in which its substance is dissipated, principally by melting. The glacier transports excess material from the accumulation area to the wastage area and, if everything is nicely in balance, the total accumulation is just equal to the total wastage. During the process of being transported from one part of the glacier to the other, the ice experiences solid flowage and its crystalline texture and structure are greatly altered. This modification is roughly the same as that experienced by a sedimentary rock metamorphosed by solid flowage.

Studies of the Seward-Malaspina system show that Malaspina Glacier has experienced a strong deficit in its material balance sheet in at least 6 out of the 9 recent budget years. This means that it is wasting away rapidly, and indeed the marginal zone of this great piedmont ice sheet is stagnant, heavily covered by ablation debris, and in places supports a luxurious spruce forest with trees up to 100 years old growing in the debris on the surface of the ice. Complete melting of the ice in two localities of limited extent has exposed remains of interglacial forests overridden by this glacier at the time of its last advance. A sample of wood from one of these localities was too young to be dated by Carbon-14 analysis and is estimated to be less than 300 years old. This relation and the age of the trees now growing on the ice fix the time of the last advance of the Malaspina Glacier at about 200 $\pm$ 25 years ago.

Seismic reflections show that Malaspina Glacier lies in a basin the floor of which is at least 700 feet and possibly as much as 1000 feet below sea level. The maximum thickness of ice in this basin exceeds 2000 feet. Since the margin of the glacier is everywhere above sea level, the ice must move up hill in its outer part, and the mechanism by which this occurs is something of a puzzle to glaciologists. Deformation of a pipe in a nearly vertical 1000-foot bore hole near the center of Malaspina Glacier indicates that this up-hill flow is not due to the extrusion of an underlying plastic layer. Some other mechanism, perhaps one of surfaceward movement along inclined slip planes in the glacier, may be involved. It has been learned from the deformation of the pipe in this bore hole that ice will flow under extremely small shear stresses amounting in some instances to not more than 100th of a kilogram per square centimeter.

Investigations have also been made of the crystal relations within these glaciers, and it is most impressive to realize that ice crystals the size of a man's head, now found near the outer edge of Malaspina Glacier, have been formed by the welding together of almost countless snowflakes. As the glacier flows, the ice recrystallizes and larger crystals ultimately develop as a result. These crystals have a definite optical or crystallographic orientation, and striking orientation patterns have been discovered in the ice of Malaspina and other glaciers. These patterns, however, as they now appear, do not seem to represent something that was formed during the original process of flowage but rather have developed subsequently by recrystallization after flow ceased.

The most impressive structural features of the Malaspina Glacier are huge folds involving the individual ice streams and medial moraines composing this ice sheet. These folds look like normal anticlines and synclines, but actually they represent deformation of nearly vertical elements rather than nearly horizontal strata. The structures are thought to have been created within the ice sheet as it spread out on the nearly flat foreland, but details of the process involved remain a puzzling enigma.

ABSTRACT OF LECTURE ENTITLED "HOW AN OIL FIELD WORKS," DELIVERED BEFORE THE SOUTHERN CALIFORNIA ACADEMY OF SCIENCES, ON FEBRUARY 17, 1956

By MAX J. TAVES

of the Richfield Oil Corporation

Californians are walking around on top of more than $15 billion that may never be used. This is an estimate of the value of crude oil that may be forever wasted in our underground reservoirs if modern oil conservation practices are continually ignored.

The state's proven oil reserves are estimated at approximately 4 billion barrels. By use of presently known conservation measures that make maximum use of underground energies, reserves can be increased by at least five billion barrels. Thus, priced at $3.00 per barrel, the oil that California owns but may never recover is worth at least $15 billion.

Oil production was demonstrated by means of a working model of an oil field. The model showed how tremendous pressures existing underground are used to recover oil and how more oil can be recovered when these pressures are placed under single control through "unitization" of an oil field. The cutaway model displayed a porous-rock reservoir containing separate layers of water, oil and gas which are trapped in "loose" rock surrounded by impermeable stone. When the high-pressure reservoir is pierced by a well, a low-pressure area is created at the well. Oil, lacking the energy to move through the rock's pores, is pushed ahead by the compressed gas and water which expand toward the low-pressure well bottom like air rushing out of a balloon. Though it is impossible to recover 100% of the oil in a reservoir, the model showed that by proper use of the natural pressure system recovery of as high as 70% of the oil can be effected.

In California today as much as 75% of the oil in a reservoir is left there because of wasteful methods encouraged by an antiquated law called the "rule of capture." Under this law producers sometimes find themselves in a race to drill as many wells as possible in order to protect their interests. In the race between the many individuals, the energy of compressed gas is used so rapidly and carelessly that much of it comes to the surface before it can perform its natural function of pushing the oil ahead of it. Therefore, the only way to effect maximum economic recovery from a reservoir is to treat it for what it is, "a single unit of energy."

This "unitization" method of conservation means that rather than fight a battle in which everyone loses, owners and operators cooperate to withdraw oil uniformly, and to maintain and even replenish the gas and water energies that make oil recovery possible.

California, which is the only important oil producing state without an effectual conservation law, should have a majority-rule "unitization" law now. Under such a law, a reservoir would be produced by "unitization" methods if an overwhelming majority of the interests voluntarily agreed to such operation. Minority rights would be protected by all due process of law, including the courts, and all interest would share in recovery of a greatly increased amount of oil.

Instead of a voluntary majority rule now, a small minority can compel a great majority to waste oil that is the lifeblood of our economy.

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MEMOIRS

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AN INTRODUCTION TO EARLY WESTERN AMERICAN PREHISTORY

By Ruth DeEtte Simpson

Associate Curator, Southwest Museum
Los Angeles, California

Man's occupation of western North America during late Pleistocene times is the most challenging and critical aspect of contemporary American archeology.

The arid portions of the western states constitute a rich and little-known field for those investigating the problem of early human occupation of the western hemisphere. The material presented herewith is a summary of significant data and resultant interpretations derived from the early western sites.

It is well known that during the Pleistocene, when glaciers cloaked the mountains, the intermontane valleys and basins were subjected to pluvial climate, were characterized by extensive drainage systems and were, therefore, natural habitat for grazing and predatory animals. The intermontane region was also ideally suited to the needs of hunters during late Pleistocene and early post-Pleistocene times. Today, the Pluvial lakes and streams are gone, but proof of their previous existence remains in fossil landforms. The evidence of Pleistocene and early post-Pleistocene human occupation is closely associated with those landforms.

Campsites, hunting sites and workshops are usually on unprotected river terraces and lake shores where perishable objects are destroyed by the elements. Therefore our study of early human occupation has been predominately a study of Man's early lithic industries. This lithic record can readily be divided into two principal parts: an early phase featuring rather heavy lithic implements and devoid of stone weapon points; a later phase in which lighter, finer implements and weapon points are present.

The beginning of modern climatic conditions may, temporarily at least, be accepted as a terminal date for that aspect of western

archeology commonly designated as "early Paleo-Indian occupation." Therefore, as a working basis, it is suggested that the lithic record of early human occupation extended from an as yet undetermined time in the Pleistocene until the beginning of the Medithermal Period, and was divided into two major sections; the division being determined in part by the appearance of stone weapon points prior to the close of the last, or Wisconsin Glacial Epoch.

Much has been written and will be written about the various weapon-point horizons. Therefore, this article shall be confined to the less publicized material representing the more generalized earlier lithic industries.

Scientific investigations of sites yielding only Early Paleolithic-type specimens were under way in the 1920s and 1930s (Rogers, Malcolm J., 1939; Harrington, Mark R., 1934; Simpson, George G., 1933; Renaud, Etienne B., 1936, 1938, 1940). However, as so frequently happens to work done in the vanguard of science, little attention was paid to those investigations and no one furthered the work until 1950. Thus, in 1950, our knowledge of western American late Pleistocene archeology was confined to scattered, isolated, little-known, little-appreciated, but tremendously important chapters in the story of American prehistory. It is interesting to note that this early work was far better appreciated in Europe than in America, because so much more work had been done pertaining to Old World early prehistory, and because that investigation had begun a century earlier than in the United States.

What is presented here, then, is the story told by those early American discoveries and by the work a handful of us are doing to extend and interpret the non-weapon-point artifact assemblages. For simplicity's sake, these assemblages shall be referred to as "early lithic industries."[1]

Our concept of the age and extent of these lithic industries has changed enormously during the last two decades. Nearly all archeologists now agree that Man was here 20,000 years ago and many fieldworkers are willing to accept a much greater age. Radio-carbon dates are lending strong support to the scientists who favor a long Pleistocene occupation. As we shall see presently, there is one desert locality older than 23,800 years as dated by C-14. There are also other sites which have been dated at approximately 20,000 years. Thus far, early dates are rare because

[1]At no time henceforth does the term "lithic industry" imply consideration of later weapon-point assemblages.

perishable material needed for C-14 tests is preserved primarily in caves, and few undisturbed caves have been discovered by archeologists. Since most of the known ancient campsites are open sites, we are, therefore, dependent upon geologists, paleontologists and climatologists for estimated dates.

Evidence of early lithic industries is being recovered from widely scattered sites, especially within the arid portion of western North America. An increasing number of America's archeologists are convinced that, from Wyoming to Baja California, from California's deserts at least as far inland as the Rocky Mountains, Texas and Sonora, there were widespread, unspecialized, Lower Paleolithic lithic industries. The extent to which these industries were distributed is being revealed as a progressively increasing number of investigators in an ever-widening area become interested in and acquainted with the crude, unspectacular artifacts as they lie inconspicuously among the natural stones.

In general, it may be said that the early lithic industries have the following characteristics which are as applicable in Wyoming as they are in California:

1. The majority of artifacts are choppers, cleavers, coup de poing-like implements, side scrapers and cutting edges. Most of these specimens belong in the "heavy equipment" category and have been shaped by the percussion method of flaking. Some artifacts show evidence of re-utilization and supplementary flaking by later craftsmen as witnessed by the different degree of patination on more recent flake scars, and by sharper edges.

2. Implements are fashioned from materials at hand—pebbles and cores of native rock. There is virtually no evidence of inter-areal trade. Of course, pottery is totally absent from the early sites.

3. As would be expected, the early lithic industries must be subdivided into minor cultural and temporal phases. However, the study of this material is just beginning, and refinements of classification cannot be undertaken as yet.

4. On many of the older specimens, patination is deep and heavy—flake scars being patinated until they are frequently indistinguishable by color from the remainder of the specimens' surfaces. Sharp edges are smoothed, even rounded, by sand and/or water action. While patination and weathering are elusive, uncertain criteria, they can, if handled with caution, supply valuable information. This is true particularly on mixed sites where early and late artifacts are found in association (as in blow-outs and on terraces). There, later tools fashioned from the same material, exposed for a shorter length of time to the same

climatic and soil conditions, show little or no weathering or patination in comparison with the older implements. Thus, patination and weathering, which are much dependent upon the nature of the stone involved, are important clues to relative age.

5. One other important aspect of collections made on the early sites should be noted: the large percentage of specimens which show only edge or marginal uniface flaking, and which are amorphous or lacking distinctive form. Whether these objects were fashioned by Man, nature or the elements is frequently debatable. However, the retention of a representative collection of these specimens seems justified when they are found on definite sites associated with unquestionable artifacts.

Investigators, sincerely interested in learning the story old stone tools can tell, know that they must proceed slowly and with caution as they attempt to distinguish between accidentally flaked stones and those that have been worked by Man. Happily, there are criteria of various kinds which enable the scientist to recognize with greater certainty Man's handiwork. For example:

1. Crudely flaked specimens assume greater importance when found in an area which was obviously free, during Pleistocene as well as recent times, from violent stream or wave action.

2. It is not sufficient that one or two crude tools be found. If there are many in a comparatively small area, it argues in favor of Man's presence.

3. It is highly desirable that charcoal or perishable material be found with lithic implements to permit radio-carbon dating; it is also highly desirable that identifiable Pleistocene animal bones and shells be associated with the stone tools. However, such criteria can seldom be met on open sites. This is one reason why the stratified Tule Springs Locality in Nevada is of vital significance.

4. It is necessary to be exceedingly critical of a site where all specimens are crude, amorphous, and flaked only along the edges. It is reasonable to expect that any site, worthy of consideration, will yield some unquestionably man-made tools.

Since the need for irrefutable artifacts is urgent, it is important that investigators be in agreement on what constitutes such an artifact. In the first place, the form and flaked edges must create a tool satisfying a specific human need—as a cutter, scraper, chopper, etc. The form of the implement must fit comfortably the human hand. The flake scars must run from the edge onto one or the other face of the artifact since Man drives flakes off by

striking an edge where he may utilize a natural or prepared striking platform. In the vast majority of cases, the flaked edge will form, with the dorsal and ventral surfaces, an accute angle. Flaking should be concentrated to form a working edge, not scattered promiscuously. The working edge may often bear appropriate use-scars.

It is desirable, though not always necessary, that there be a few biface tools—tools with flaking running from the edges over both ventral and dorsal surfaces. If flaking is alternate, that is, if a flake is thrown from one surface, the next flake from the other and so on, the implement is certainly man-made. And, parenthetically, it should be noted that there are certain methods of flaking which are too complex and which evidence too great an application of logic to be produced with any regularity by nature.

Thousands of these unquestionably man-made implements, collected from more than a hundred early sites cannot be rejected as accidental. They were purposefully shaped to meet specific human needs.

The early lithic-industry sites occur with diverse types of fossil landforms: on high lake terraces (Clements, Thomas and Lydia, 1953); on the shores of extinct shallow lakes and cienegas (Simpson, Ruth D., 1952); beneath lake and pond deposits (Harrington, M. R., 1934, 1955, Simpson, George G., 1933; Simpson, R. D., 1955); on high terraces (Renaud, E. B., 1936, 1938, 1940); and buried in deep valley fill (Carter, George F., 1954; Simpson, R.D., 1954).

Thus far in our investigations, the three localities which are most important are Black's Fork in southwestern Wyoming, Tule Springs in southern Nevada, and Texas Street near San Diego, California.

The Black's Fork Locality (Pl. 16) is of prime importance because there we have more than seventy sites on which there are abundant diagnostic tools characteristic of the Lower and Middle Paleolithic. Amply represented are techniques typical of Pre-Chellean, Chelleo-Acheulean and Mousterian workmanship. Here, as in Europe, Asia, Africa and South America, is the extremely early Paleolithic development: the Pebble Industry (Renaud, E. B., 1955). At Black's Fork, this is a basic element in the sequence of lithic industries. On marginal sites, some later artifacts of Mesolithic and Neolithic types are found (Renaud, E. B., 1938, p. 31).

Since these are surface sites, implements representing the various lithic horizons are frequently mixed. However, the varying degrees of patination and weathering, combined with the varying

PLATE 16

Black's Fork Locality. Southwestern Wyoming.

degree of evolutionary development of technique, specialization of form and refinement of purpose, permit the establishment of a well-ordered series. It is possible, then, to develop helpful systematic classifications on the basis of appearance.[2]

Among the oldest Black's Fork specimens, the most important and numerous tools are choppers and coups de poing fashioned from cores and pebbles (PL. 18). These heavy implements are accompanied by a variety of scrapers, pointed tools, cutting edges, short blades (in the true European sense of the word), unmodified Clactonian flakes and other flake implements. Side scrapers are notably abundant.

[2]The writer sees no reason to give diverse names to techniques and tools just because they are found in widely separated parts of the world. Therefore, the accepted European terms and periods are used when such use is justified by the material at hand. Universal terminology simplifies description; it does not imply equation of time; it indicates the stage reached in the evolution of lithic workmanship, it does not pertain to geological or absolute chronology.

PLATE 17

Tule Springs Locality. Southwestern Nevada

The Tule Springs Locality (PL. 17) is of prime importance because the presence of ash and charcoal has permitted the University of Chicago Institute of Nuclear Studies to date Man's presence here at "more than 23,800 years" (Libby, Willard E., 1954). Buried under 10 to 20 feet of lake or pond deposits, the ash and charcoal are combined with broken bones of camels, bison, horses and mammoths—all extinct Pleistocene fauna. Many of the bones have been broken and split for marrow, many are charred. There are a few bone tools and some closely associated stone tools (PL. 19). The high-backed plano-convex scraper is predominant among the implements thus far recovered. As yet, no weapon points have been found. However, excavations are incomplete and the chronological position of this site in the technical evolution of the lithic industries is tentative.

The Texas Street Locality (Carter, G., 1954) derives its importance from the fact that the crude cores and flakes and fire-broken rocks are buried beneath 50-90 feet of valley fill with a well-developed soil profile—a fact which suggests Man's presence either late in Third Interglacial or very early Wisconsin Inter-

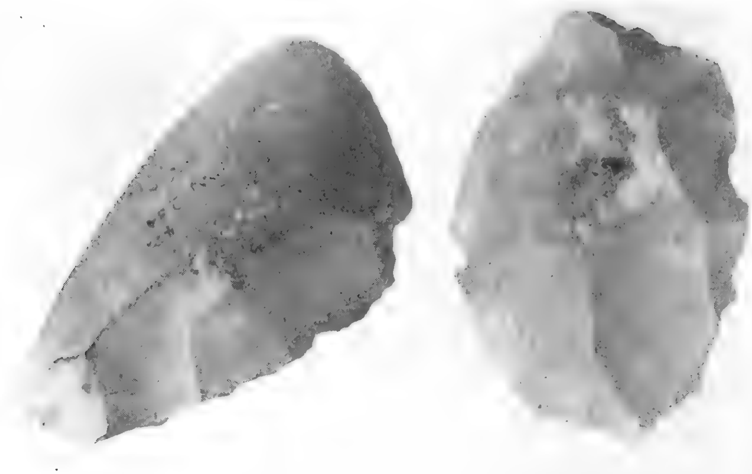

PLATE 18

Typical Pebble Industry Implements, Black's Fork, Wyoming.
(Side chopper and coup de poing.)

stadial times. In either case, the presence of Man at the Texas Street Locality appears to more than treble the "maximum age" previously accepted for Man in America.

SUMMARY: The study of Early Prehistoric archeology of western America began comparatively recently and is much too young to give us decisive conclusions. However, present knowledge does provide challenging, thought-provoking data; does open new vistas; does afford a strong incentive for scholars to further their investigations into the probably great antiquity of Man in America.

Certain aspects of our study are now well established, well documented. A few of these merit inclusion in the summary of this progress report on the investigation of Early Prehistoric western American archeology:

1. Thousands of Early Paleolithic-like artifacts from many sites situated in different areas, cannot be overlooked or ignored. They represent widespread and very early lithic industries.

2. Certain criteria must be met before sites and lithic implements are acceptable as evidence of the presence and work of

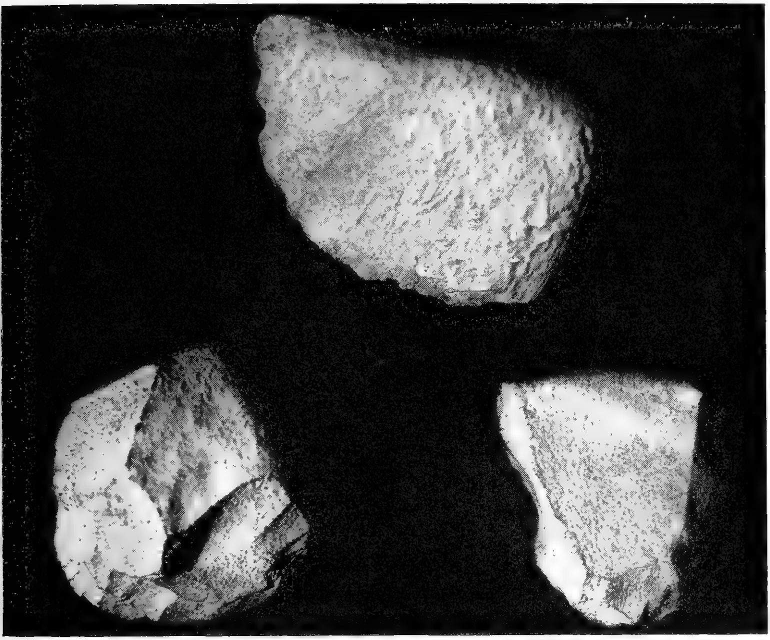

PLATE 19

Typical Chopper and Scrapers, Tule Springs, Nevada.
(Length of chopper: 11 cm.)

early Man. Some of these criteria are: the presence of artifacts undeniably fashioned by Man; implements manufactured to meet Man's specific primary needs (cutting, scraping, pounding, etc.) and which comfortably fit the human hands operating the tools in their functions.

3. The early lithic industries of western America display many of the traits characteristic of the Early Paleolithic industries of Western Europe, Africa and Asia. These traits are world-wide in their manifestation. The trend of evolution is similar: it starts with a pebble industry which is closely followed by a heavy core industry; tools are shaped by bold percussion flaking; then there is a tendency to reduce weight and size of artifacts, to extend and improve the quality of flaking, and to proceed from generalized towards specialized implements.

4. The evidence of the antiquity of Man, and of his presence in America during a relatively long portion of the Pleistocene is increasing with every new discovery. Incessantly, the arbitrary "age ceilings" are being pushed back. Unbiased scientific research is bringing new and favorable light on the problem of Man's antiquity in America.

The first exploratory phase of American Paleolithic investigation has yielded much vital information. During the initial probing stage, the foundations were laid for future work. We have now some concept of the extensive field, of tremendous potentialities, of the exacting task ahead. We are beginning to appreciate the full significance of the long chapter of Man's American prehistory which archeologists are attempting to understand and reconstruct. Thus will American archeology gain its rightful place beside the prehistory of the Old World where Africa, very rapidly, Asia, more slowly, and Australia, most recently of all, are adding their own chapters to that already written by Europe in the book of Human Prehistory. America cannot fail to make its contribution.

Dr. E. B. Renaud opened the door to a new era of scientific investigation when he became the first scientist to recognize, accept and publish the presence of Early Paleolithic industries in America. Today, the growth of this investigation is unequalled in the annals of American archeology, and the decades ahead give promise of new discoveries, new concepts that are yet but dreams in the scientific mind of America. The prehistoric horizon is widening; archeologists, encouraged by their first success, are ready and eager to explore further this immense field. They know new and significant discoveries will be made that will lead us further along the trail of Human Prehistory and deeper into the archeological and geological past. The Future will reveal the Past of Man in America.

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THE ORIGIN OF ELSINORE LAKE BASIN

By John F. Mann, Jr.

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INTRODUCTION

Lake Elsinore, one of the few natural lakes in southern California, is in Riverside County, about 75 miles southeast of Los Angeles. For many years the basin of Lake Elsinore has been recognized as being of fault origin, occupying a downdropped block, or graben, within the Elsinore Fault Zone. William Morris Davis, who visited this area in the mid-1920's, considered the escarpment along the southwest side of the lake as "a good example of a scarp in a maturely dissected and fan-bayed stage of its post-faulting evolution" (Davis, 1927). The narrow trough occupied by Lake Elsinore can be seen quite readily from the outcrop pattern of pre-Quarternary rocks shown on Plate 22 and from the aerial photograph (Plate 20).

LATE PLEISTOCENE DRAINAGE

The most recent evidence bearing on the origin of Elsinore lake basin has been derived from detailed geologic mapping and physiographic studies in an area to the southeast (Mann, 1955). In that report it was suggested that in the Late Pleistocene the major drainage flowed west across the Temecula Basin then northwest within the Elsinore Fault Zone to join the Santa Ana River. This ancient stream, named the Pauba River, flowed just northeast of the present position of the lake, through what is now the City of Elsinore (Plate 21). The Pauba River was probably forced to flow near the northeast side of the graben because of the development of large alluvial fans formed by torrents debouching from the high ridge to the southwest. The same type of asymmetrical sedimentation within the Elsinore Fault Zone can be seen more clearly northwest of Elsinore where large fans developing from the southwest side of the graben have pushed Temescal Wash to the northeast; this wash is now superimposed on the basement rocks beyond the edge of the graben.

PLATE 20

Aerial view of Lake Elsinore looking west. Taken in 1953 when the maximum depth of water was about 6 feet. (Courtesy Lake Elsinore Valley Chamber of Commerce.)

FORMATION OF THE LAKE BASIN

Fairly late in the Pleistocene the Pauba River was beheaded and diverted through Temecula Gorge. At about the same time the lake basin was formed by downfaulting of a local block within the larger graben, which was downfaulted initially about the beginning of the Pleistocene. The faults along which the movements took place are shown on Plate 23. An important consequence of the faulting was the diversion of the San Jacinto River into the downfaulted area. Overflow from the lake basin followed essentially the same course as the present Temescal Wash. The diversion resulted in a wind gap (Plate 24).

PROBABLE DESTRUCTION OF THE LAKE BASIN

All lake basins, geologically speaking, are short-lived. Destruction of lake basins may take place by (1) filling, or (2) rim erosion. It is not possible to state how the eventual destruction of Elsinore lake basin will come about; nevertheless, certain

lines of reasoning can be presented which may bear on its ultimate fate. At present, little sediment is reaching the lake because essentially all the flow of the San Jacinto River and its tributaries must pass through Railroad Canyon Reservoir. Assuming that at some time in the future Railroad Canyon Dam will be destroyed, sediment will again reach Lake Elsinore. It is quite possible that destruction by rim erosion will occur in advance of filling. At point B (Plate 24), the present outlet, erosion must be accomplished on hard basement rocks by water essentially devoid of suspended load, during those rare times when the lake overflows. That erosion must necessarily proceed slowly. Furthermore, the overflow must pass across a block which appears to be rising actively, and the amount of erosion required to destroy the lake basin may be much more than is now indicated. At point C, another low spot on the rim, erosion is proceeding at a slower rate than at the outlet. From all present indications, point A is where the eventual destruction of the rim will take place. Since some time during the late Pleistocene, when the drainage of the Temecula Basin was diverted through Temecula Gorge, a subsequent tributary (Murrieta Creek) has been lengthening to the northwest within the Elsinore Fault Zone and now this drainage has reached to within a mile or so of the shoreline of the lake when full. The divide separating the Murrieta Creek drainage from the lake drainage is only a few tens of feet high and consists of soft alluvial deposits. Continued headward growth of Murrieta Creek seems assured and the indicated period of erosion required to destroy the lake basin is rather short. Upon completion of this diversion, the San Jacinto River, which is now a tributary of the Santa Ana River, will join the drainage of the Santa Margarita River.

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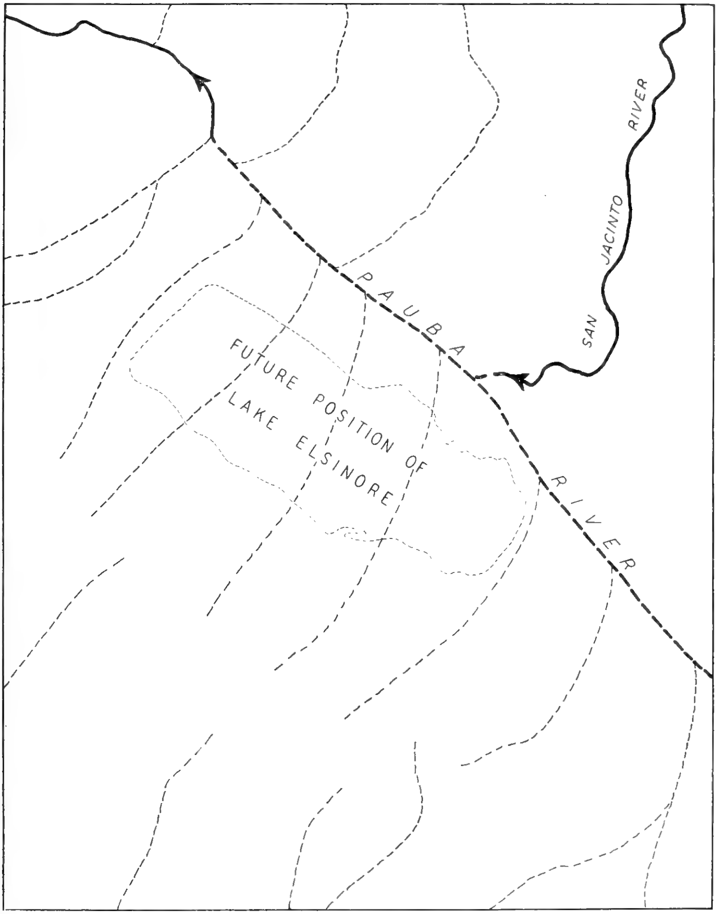

PLATE 21

Suggested drainage in the Lake Elsinore area during Late Pleistocene time (before the lake basin was formed).

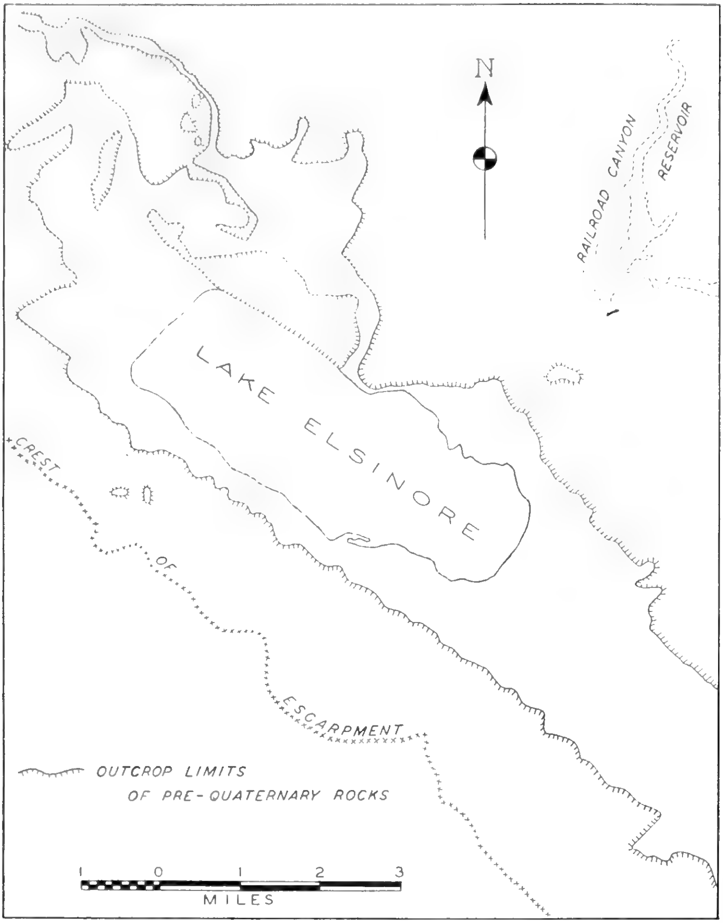

PLATE 22

Distribution of Quaternary and pre-Quaternary rocks in the vicinity of Lake Elsinore.

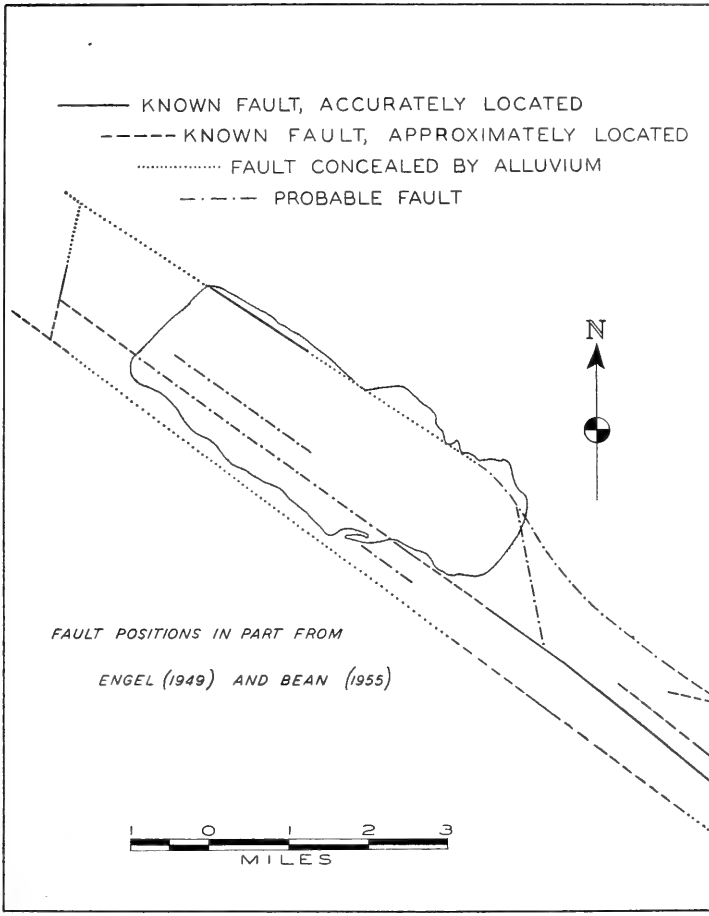

PLATE 23

Fault lines which have had a part in the formation of the basin of Lake Elsinore.

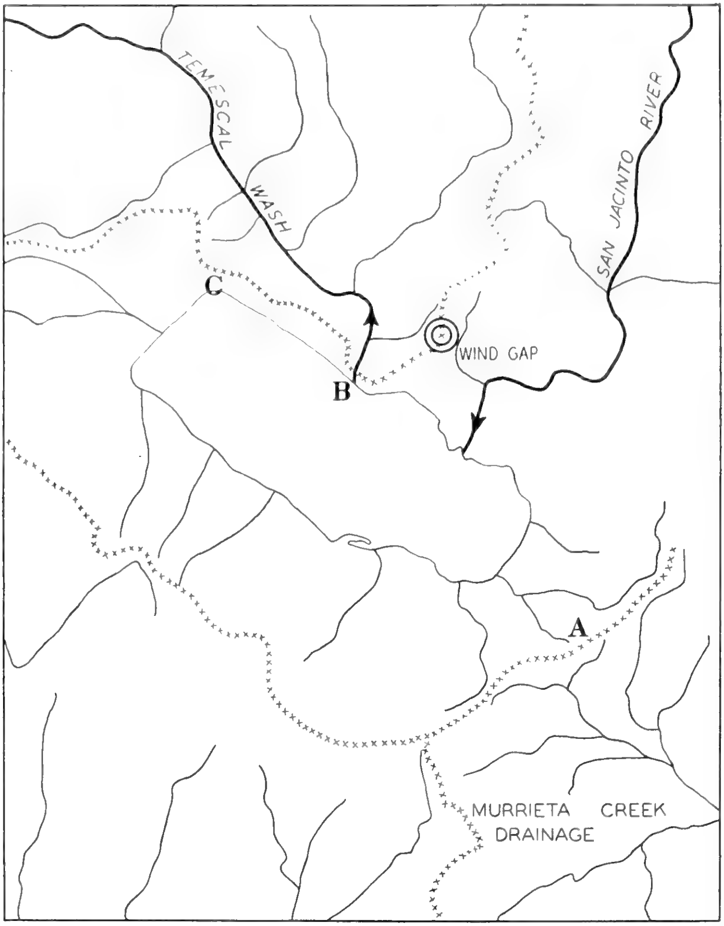

PLATE 24

Present drainage pattern in the vicinity of Lake Elsinore, showing the postulated wind gap and the points where the lake basin may be destroyed by rim erosion.

NOTES ON TWO ANOMURAN CRUSTACEANS NEW TO CALIFORNIA WATERS[1]

By Janet Haig

Allan Hancock Foundation,
University of Southern California

Among the decapod crustaceans in the collections of the Allan Hancock Foundation are two species of Anomura, collected off the California coast, which have never been reported from that state. The specimens were taken by the Foundation's research vessels Velero III and Velero IV in the period between 1941 and 1955. It seems advisable at this time to record these additions to the California crustacean fauna.

GALATHEIDAE

Munidopsis depressa Faxon

Munidopsis depressa Faxon, 1893, p. 189; 1895, p. 96, pl. 22, figs. 2, 2a-b.

The holotype was collected by the Albatross off Tres Marias Islands, Mexico, at 680 fathoms. This appears to be the only specimen on record.

Six specimens were taken by the Velero IV off southern California from four stations between Santa Catalina Island and the mainland, at 400-450 fathoms. The carapace of the largest male measured 20.3 mm in length, exceeding the 19 mm given by Faxon for the holotype. A specimen from one of the Hancock stations has already been listed by Hartman (1955, p. 95).

Following is Schmitt's (1921, p. 168) key to the California species of *Munidopsis*, modified to include *M. depressa*.

I. Abdomen unarmed. Eye-stalks spined above. Rostrum acuminate, laterally unarmed. Chelipeds hairy.
verrilli Benedict

---

[1]Hancock Foundation Contribution No. 177. This study was supported in part by a grant from the National Science Foundation. The author wishes to thank the administration of the Allan Hancock Foundation for the use of facilities, and Dr. John S. Garth for reading the manuscript.

II. Abdomen armed with spines or tubercles.

A. Eye-stalks spined above. Dorsal armature of abdomen not confined to median line. Chelipeds hairy. Rostrum lateraly spined. *hystrix* Faxon

B. Eye-stalks not spined. Dorsal armature of abdomen confined to median line.

1. Rostrum not armed with lateral spines.
   a. Anterior margin of carapace with a small, serrated lobe on either side of base of rostrum behind ocular peduncle; lateral margins arcuate. Chelipeds hairy. *aspera* (Henderson)

   b. Anterior margin of carapace straight, at right angles to lateral margins; lateral margins straight. Chelipeds not hairy. *quadrata* Faxon

2. Rostrum laterally spined. Carapace with a row of 4 large median spines; segments 2, 3, and 4 of abdomen each with a large median spine. *depressa* Faxon

PORCELLANIDAE

Polyonyx quadriungulatus Glassell

Polyonyx quadriungulatus Glassell, 1935, p. 93, pl. 9.

The type specimens of this species were collected at Estero de la Punta Banda, Baja California, Mexico, about 65 miles south of the California border. Steinbeck and Ricketts (1941, p. 458) reported it from El Mogote in the Gulf of California. Besides its California material, the Hancock Foundation collections contain specimens from several localities on both sides of the Baja California peninsula.

The Velero III and Velero IV took nine specimens from six southern California stations, at Santa Rosa, Santa Cruz, and Santa Catalina Islands. The species was found on two occasions in *Chaetopterus* tubes, this being the most common habitat for the genus as a whole; three times it was recovered apparently free-living (with sand and mud bottom recorded in one case); and on the sixth occasion it was taken from kelp holdfasts. The depth range was 2-25 fathoms. The genus, as well as the species, is new to California waters.

The only other species of *Polyonyx* reported from the west American coast is *P. nitidus* Lockington (1878, p. 405), from Baja California, exact locality unknown. It is unfortunate that Lockington's type (the only known specimen) is no longer extant, presumably having been destroyed in the San Francisco earthquake and fire of 1906, for a comparison of the two species would be highly desirable. Glassell distinguished *P. quadriungulatus* from *P. nitidus* on the basis of three characters: (1), hands unequal, instead of equal as in *P. nitidus*; (2), carpus of chela two-thirds as wide as long, instead of "about twice as long as wide"; (3), dactyli of ambulatory legs with four unguicles, instead of with three to five as in *P. nitidus*. All the other characters given in Lockington's brief description apply equally well to either form.

The California specimens varied greatly in the second character, having carpi from 53 per cent to 67 per cent as wide as long; therefore this distinction does not appear to be valid.

Probably not much weight should be given to the variation in the number of unguicles on the dactyli of the walking legs reported by Lockington for *P. nitidus*. The unguicles are not always easy to see even with the modern binocular microscope, and the counts made by Lockington may perhaps be attributed partly to weaker magnification. In one of the California specimens examined, only three unguicles were present on one dactyl but it could be seen under high magnification that the fourth had been broken off. In several cases, also, two distal unguicles were partially grown together and appeared almost as one.

Thus it seems to the writer that two of the characters on which Glassell based his new species are of only questionable validity. The first character mentioned, however, that of the structure of the hands, immediately sets the two forms apart. Lockington stated twice that the hands were equal in his species, but in *P. quadriungulatus* they are quite obviously different. It appears that the two species must be kept distinct on this basis alone, at least until such time as future collecting in the Baja California and Gulf of California area reveals more examples of *P. nitidus*.

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BIOLOGICAL OBSERVATIONS ON PTILOTHRIX SUMICHRASTI (CRESSON) AND SOME RELATED GROUPS OF EMPHORINE BEES

(Hymenoptera, Anthophoridae)[1]

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During the months of July and August, 1954, at several localities in the vicinity of Fresnillo, Zacatecas, Mexico, opportunities were afforded to observe the habits of *Ptilothrix sumichrasti* (Cresson)[2] and to make comparisons with *Melitoma euglossoides* Lepeletier & Serville[3] and several species of *Diadasia*[4]. These observations permit further generalizations on the biological characteristics of emphorine bees (Linsley, MacSwain and Smith, 1952a) as well as comparisons between *Ptilothrix* and *Emphor* on the basis of the extensive literature on *Emphor bombiformis* (Cresson) (Robertson, 1890, *et seq.*; Grossbeck, 1911; Nichols, 1913; Rau, 1930; Michener, 1947; and others). More detailed accounts of the habits of *Melitoma euglossoides* and the Mexican *Diadasia* will be published elsewhere.

BIOLOGY OF *Ptilothrix sumichrasti* (CRESSON)

LOCALITIES, Three localities were involved in the observations on *Ptilothrix sumichrasti*. The first was 17 miles north of Fresnillo, Zacatecas, where notes were made by J. W. MacSwain and E. I. Schlinger between July 14 and 16, 1954. The other sites were 1.5 and 9 miles south of Fresnillo, respectively, where observations were made by the authors during the first and second weeks of August. All three sites were characterized by flat, hard-packed, barren areas suitable for nesting, nearby sources of water, and an abundance of *Ipomoea longifolia* Benth[5]. and *I. pringlei* Gray[5], the pollen plants utilized by *P. sumichrasti* in this part of Mexico.

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[1] The observations reported here are part of a series of studies made possible by a grant-in-aid from the Associates in Tropical Biogeography, University of California.
[2] Identified by C. D. Michener. This species was inadvertently referred to by Linsley, MacSwain and Smith (1954:264) as *Emphor bombiformis* (Cresson), a species not known to occur in Mexico
[3] Identified by C. D. Michener.
[4] Identified by P. H. Timberlake.
[5] Identified by Helen K. Sharsmith.

Ptilothrix sumichrasti was described from "Mexico" by Cresson (1878) as *Melissodes sumichrasti*. The authors do not have data on the general distribution of the species[6]. Presumably it occurs throughout much of Mexico in areas of summer rainfall where *Ipomoea* and suitable conditions for nesting exist together, although we did not encounter it except near Fresnillo.

Nest construction. In the vicinity of Fresnillo, *P. sumichrasti* was found nesting in flat or gently sloping surfaces in areas where the soil was hard-packed. Excavation of burrows in these sites proved difficult, and required a mattock or chisel[7]. *P. sumichrasti* digs by moistening the soil and cutting away the dampened portion.

Female bees were observed taking water from five sources. One was a shallow well, from six to eight feet in diameter, with the water surface three or four feet below the ground level. Another was a small pool in a sandy wash, which dried up during the few days that it was being observed. A third source consisted of several rather extensive marshy pools beside a highway which differed from the others in having considerable vegetation growing up from the water. The remaining sources were a small shallow reservoir and a series of small potholes eroded out of the adobe soil in the drainage from the reservoir. These last were visited by the bees more frequently than the larger reservoir. In each of these cases the water was still and was located immediately adjacent to the nesting sites.

When visiting a water source the female alights on the surface, usually away from the edge, and obtains a load of water in from 4 to 6 seconds. The majority of the visits observed by us were between 5 and 5½ seconds in duration. When resting on the water the hind legs are held backwards and outwards from the body, the mesothoracic legs are placed forward and away from the body and the fore legs are extended slightly forward in front of the head and to the side. Females appeared to have no difficulty in alighting on the water or taking off, and no drowned individuals were found. Information as to the times during the day when females were engaged in taking water for nest construction is fragmentary and no attempt was made to follow the daily pattern of an individual female. One water source which was under observation from 7:30 to 10:00 a.m. was not visited by bees during this period. However, in one case a female was seen using water to begin a burrow at 11:30 a.m., in another at 12:25 p.m. The latest that we recorded bees taking water was

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[6] However, Michener (*in litt*) found this species nesting about 3 miles west of Rachuca, Hidalgo, Mexico, under conditions similar to those described here.

[7] Adults, larvae and casts of burrows and cells have been deposited in the collection of the California Insect Survey, University of California, Berkeley, California.

3 p.m. However, many females were still engaged in this activity at that time and it is likely that they continued for an hour or more.

Excavation consists of alternately moistening the hard-packed soil and cutting it away to form moist mud pellets. The first pellets excavated are used to construct a very short turret, 3 to 5 mm. in length, which is fashioned by passing the mud pellets back to the hind legs and forcing them into position with abdominal pressure. The female rotates around the developing turret so that upon completion all parts of the lip are at a uniform height. The inside of the turret is smooth, the outside pebbled (fig. 1). The lip is also smooth and it is beveled so that the entrance diameter is slightly larger than that of the remainder of the turret and that of the main burrow.

When the turret has been completed, additional mud balls are brought to the lip and thrown out in the characteristic manner which has been reported for *Emphor bombiformis*. During this procedure the bee emerges backwards from the turret, holds the mud pellet against the lip with the ventral apex of the abdomen, and kicks the pellet with the hind legs. Bees were seen to throw pellets as far as 13 cm. from the entrance and, in a few cases, pellets were found on the surface of the ground at considerably greater distances (e.g., 23 cm.). The pellets are thrown out in such a manner that they are rather uniformly distributed in various directions from the entrance. From one to four pellets result from the excavation activities between trips for water (most commonly two or three). There was no correlation between the number of pellets produced and the stage involved in the construction of the main burrow shaft. Nor was the number of pellets correlated with the length of time spent in the burrow between trips for water. This last reflects the stage of construction of the main shaft. For example, a female was timed for the first eighteen excavation periods from the start of her burrow and spent the following times in the burrow: the first six periods averaged 46 seconds (range 22 to 69), total 17 pellets; the next six periods averaged 76 seconds (range 62 to 86), total 17 pellets; and the last six periods averaged 92 seconds (range 84 to 98), total 13 pellets. Conversely the time spent on trips for water decreased as follows: the first six trips averaged 36 seconds (range 18 to 70); the next six trips averaged 23 seconds (range 16 to 41); and the last six trips averaged 20 seconds (range 17 to 23). This female also ceased construction activity twice for extended periods but these are not included in the above summary. The first of these occurred after two round trips for water and the female remained away for nine minutes, then returned, and spent five seconds in the burrow before flying off for water to resume excavation. The second period was after eight addi-

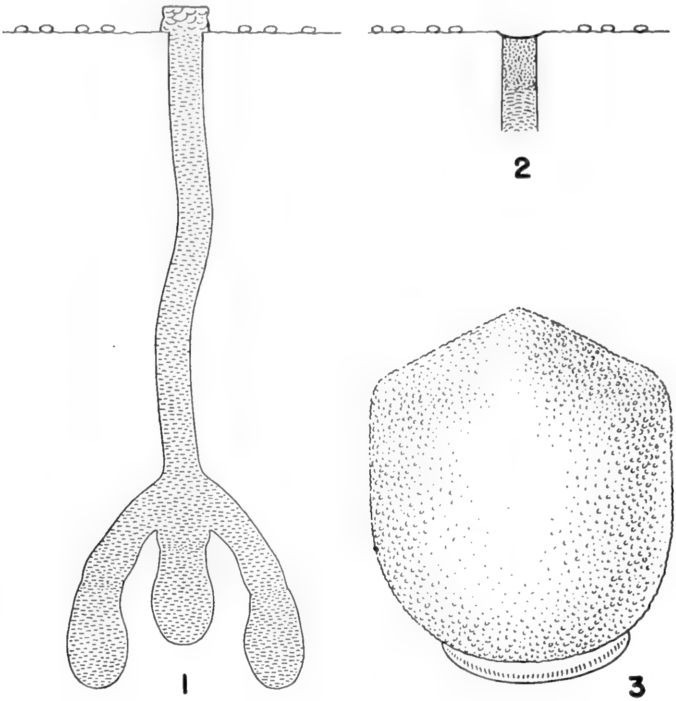

PLATE 25

Figure 1. Burrow of *Ptilothrix sumichrasti* (Cresson) (X 1½). Figure 2. Plugged burrow entrance of *P. sumichrasti* (Cresson) (X 1½). Figure 3. Pollen mass and egg, *in situ,* of *P. sumichrasti* (Cresson) (X 7).

tional trips for water. This time the female was gone for seven minutes and fourteen seconds and after returning, she remained in the burrow for seven minutes. The trips for water after each of these periods was also longer than average, being 50 seconds after the first and 41 seconds after the second period. Following the last eight trips the female was gone for another extended period and our observations were terminated before she returned.

Presumably, these three long periods were spent in taking nectar and resting.

Excavation of the burrow shaft progresses rapidly (the form of the completed burrow is indicated in figure 1). The female referred to above excavated to a depth of 13 mm. in fourteen minutes, in addition to fashioning a turret. In an elapsed time of 53 minutes, of which approximately 24 were spent in other activities, (see above), she had reached a depth of 35 mm. Another female constructed a turret and dug to a depth of 82 mm. in a two and one-half hour period. Since the depths of the various burrows excavated by us ranged from 65 to 115 mm., it is likely that the entire burrow shaft is constructed in a single day. However, our data indicate that the construction of the first cell requires an additional day.

The diameter of the main shaft was found to vary from slightly more than 4 mm. to 5 mm. The burrows deviate only slightly from the vertical and have a conspicuous enlargement at the bottom of the main shaft just above the first cell. Similar but slightly smaller enlargements are constructed in lateral tunnels leading to additional cells. Nothing quite comparable to these enlargements has been found by us in the tunnels of other anthophorid bees. When a burrow with a single unprovisioned cell is filled with Plaster of Paris, the resulting cast suggests two cells in series. The upper enlargement probably permits the bee to turn around in its burrow.

The cells of *Ptilothrix*, like those of most anthophorids, are urn-shaped externally and are constructed within a larger cavity so that they can be removed intact. External measurements of twenty cells varied from 17.5 mm. to 22 mm. in length, and a maximum diameter of 14.5 mm. Internal measurements were from 13 to 15.3 mm. in length and from 9.5 to 11 mm. in diameter. The first cell is constructed at the bottom of the main burrow shaft and frequently this was the only cell found. More commonly, an additional one to four cells were placed around the first cell as indicated in figure 1. However, in several burrows, cells had been constructed off of the burrow leading to the second cell rather than off the main shaft. All of the cells found by us were vertical. With the exception of the cap, the inner surface is smooth but does not have a waterproof lining. The outer surface of the cap is smooth and concave, the inner surface rough and spirally arranged. The pollen mass (fig. 3) is cup-shaped but with the upper surface convex, and usually fills from two-thirds to four-fifths of the cell space. There is no surface liquid and the pollen mass can be removed intact. The egg is placed at the bottom of the cell under the pollen mass and is imbedded in it for about one-fourth its diameter. These features appear to

be characteristic of the emphorine bees (cf. Linsley, MacSwain and Smith, 1952b, plate 9, fig. 1). A single egg, preserved in alcohol, measures 5.5 mm. in length and 0.9 mm. in diameter. The chorion is minutely and densely reticulate. The reticulations are elevated and darkly pigmented, the enclosed areas about one and one-half times as long as broad, with the long axis coinciding with that of the egg. Most of the enclosed areas are hexagonal, a few pentagonal. They are largest toward the middle of the egg where they are mostly about 55 μ in length. We have found a similar network of fine thickenings in the eggs of other emphorine bees (*Melitoma euglossoides* Lep. & Serv., *Diadasia mexicana* Timberlake, *D. diminuta* (Cresson), *D. consociata* Timberlake), and in the apids (*Apis mellifera* Linnaeus, *Bombus vosnesenskii* Radoszkowski), but not in *Micranthophora, Nomia,* or *Pseudopanurgus*, the only other bee genera of which we now have eggs available for study. It would appear desirable to define more precisely the occurence of this feature throughout the Apoidea.

DEVELOPMENT. No attempt was made to rear *P. sumichrasti* through its developmental stages. However, some of the activities of the different stages were observed and others were reconstructed from evidence found in the cells. After hatching, the first instar larva cuts a deep channel in the side of the pollen mass and progresses toward the top. This channel-like method of feeding continues around the pollen mass in this and the subsequent larval instars and transforms the pollen mass into a progressively smaller sphere. Two morphologial developments of the larvae (fig. 5) are apparently associated with this unusually active feeding pattern. The long slender form of the feeding instars presumably facilitates their passage between the pollen mass and the cell wall. Also the thoracic and first eight abdominal segments have prominent, backward-projecting dorsal elevations which, together with a somewhat similar development of the ninth abdominal sternum, apparently are used in progression around the pollen mass.

When the pollen mass has been completely consumed, defecation and cocoon formation take place. During these activities, the unruptured pollen grains which have passed through the larva, are applied in a layer over the entire inner surface of the cell. This layer of excrement is not uniform. On the walls of the cell it is four to six pollen grains thick. At the bottom of the cell the layer is slightly thicker and at the top it is composed of short fecal pellets. Although these pellets are distinct, they adhere closely to each other and cannot be separated. After application of the fecal material, a thin transparent cocoon is constructed upon this new wall. The cocoon consists of a relatively few long strands of silk which adhere to the pollen grains, and

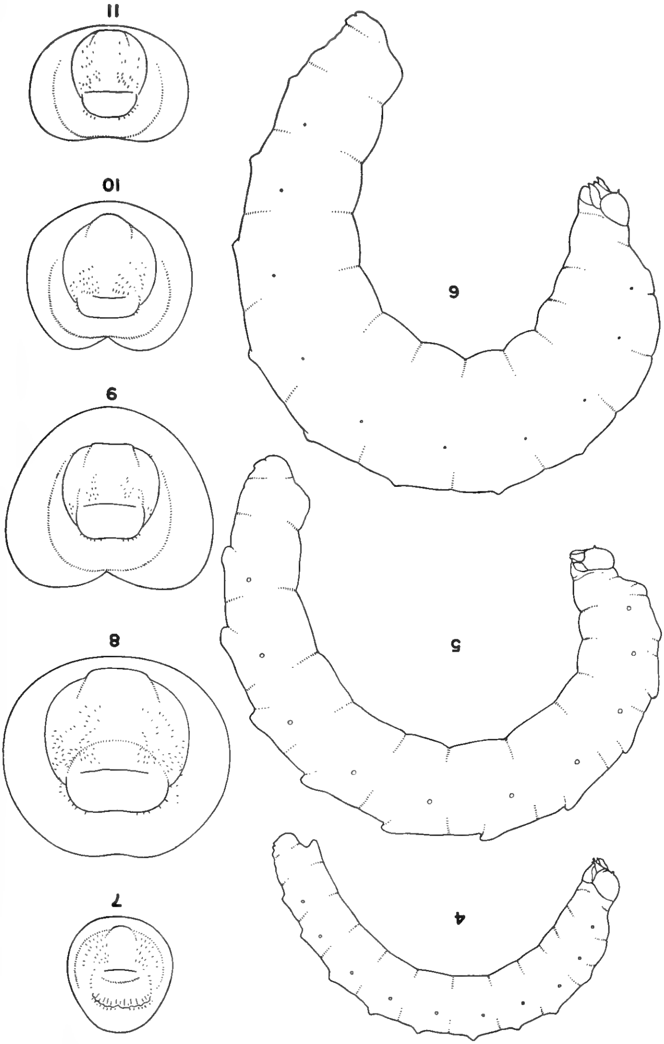

PLATE 26

Figure 4. Young larva of *Diadasia (Dasiapis) ochracea* (Cockerell). Figure 5. Half-grown larva of *Ptilothrix sumichrasti* (Cresson). Figure 6. Full-grown larva of *Melitoma euglossoides* Lepeletier and Serville. Figure 7. Anal aspect of young larva of *Diadasia (Dasiapis) ochracea* (Cockerell). Figure 8. Anal aspect of full-grown larva of *Diadasia (Diadasia) enavata* (Cresson). Figure 9. Anal aspect of full-grown larva of *Diadasia (Coquillettapis) consociata* Timberlake. Figure 10. Anal aspect of half-grown larva of *Ptilothrix sumichrasti* (Cresson). Figure 11. Anal aspect of full-grown larva of *Melitoma euglossoides* Lepeletier and Serville.

a complete inner papery layer. When this inner layer is examined microscopically it is seen to consist of silken strands which are partially coalesced and ribbon-like. As seen from the inner surface, the cocoon appears to be a thin varnish-like layer insulating the larva from its fecal material. Further morphological modifications of the larva are apparently associated with the disposition of this material. The anal opening (fig. 10) is almost dorsal on the tenth abdominal segment while the surrounding area is elevated, flattened, more heavily sclerotized than the remainder of the segment and ornamented with a pattern of small spines. The ambulatory modifications are most evident in the early instars, the anal development in the last larval instar prior to its resting stage. In the somewhat flacid overwintering larva both of these modifications are somewhat masked. Similar modifications of the anal area occur in other emphorine larvae available for study and several of these are here illustrated (figs. 7-11). Ambulatory modifications are also illustrated for *Diadasia* (fig. 4) and *Melitoma* (fig. 6).

Full grown larvae and pupae of the previous season were found in mid-July. At the same time cells of the current season contained only eggs or very young larvae. Thus it would appear that pupation occurs over a considerable period of time.

Emergence and adult activities. The earliest emergence of *P. sumichrasti* must have occurred near the first of July and the number of overwintering and transforming larvae found by us suggest that emergence would have continued until mid-August or early September, if the pupal period of *P. sumichrasti* is approximate to that of other anthophorids which we have studied (i.e., 20 to 30 days). Males probably appear somewhat earlier in the season, than the females, judging from the preponderance of female pupae found during excavation.

Copulation was not observed but undoubtedly occurs in the *Ipomoca* flowers. Males were not encountered about the nesting sites but commonly were seen flying from flower to flower and entering those which contained other bees.

It is not clear where the males spend the night. We did not find them in old burrows and only a small fraction of those in the area spent the night in flowers.

Detailed data on cell provisioning was not obtained because the observations made in mid-July were hampered by overcast and rainy weather and those in mid-August were made when the flowers had practically disappeared. On July 15, new flowers commenced opening at about 6 a.m. and shortly after sunrise, at 6:55 a.m., the heads of several females appeared at the entrances to their burrows. However, heavy clouds on the horizon

obscured the sun and light intermittent rains fell in the nesting area, and these bees did not come out. Under more favorable conditions *P. sumichrasti* probably would have been active on the flowers at this time. Even under these conditions, one female was seen visiting the flowers at 7:30 a.m., only five minutes after a male had been seen flying in the vicinity. At 7:45 another female was timed visiting five flowers in two minutes and twenty-five seconds over a linear distance of about 10 feet, after which she flew rapidly away with what appeared to be a full load of pollen. Three additional females were timed at 8:05, 8:15 and 8:32 a.m. as follows: the first visited six flowers in two minutes and five seconds but only obtained pollen from three; the second visited ten flowers in three minutes and twenty seconds but apparently collected pollen from only four of these; the third took pollen from three or four of eleven flowers in three minutes and forty-five seconds. During these observations the rain continued and by 8:30 a.m., considerable water had accumulated at the base of the flowers. The bees spent from 20 to 45 seconds (mean 30) for visits in each flower from which pollen was gathered, and a considerable portion of this period was spent on the pistil packing the pollen on the legs. From these limited data and what it known of the flowering habits of *Ipomoea longifolia,* it is apparent that pollen is gathered only in the early morning, that the number of flowers required to furnish a full load is few, and only sufficient pollen for a single cell can be gathered by the bee in any one day.

Female *Ptilothrix* undoubtedly construct and provision several burrows during the season, but the factors which determine the number of cells associated with each burrow are not known. However, after provisioning from one to five cells the female plugs the burrow. There are two plugs involved. The inner plug is just within the entrance and extends from 1 to 1.5 cm. down into the burrow. It is loosely constructed and may actually be made up of a number of different layers. The surface plug is a compact layer approximately 0.7 cm. in length and is concave at the surface as illustrated (fig. 2). The process of sealing a burrow was not observed but the turret is demolished and presumably is used for constructing the plug.Whether or not some of the scattered pellets from the original excavation are also used remains to be determined.

EFFECTS OF PHYSICAL FACTORS. As previously mentioned, *Ptilothrix sumichrasti* is apparently restricted in its distribution by a combination of soil requirements (bare, flat, hard-packed), availability of water, and presence of its pollen flower.

The weather in the vicinity of Fresnillo during the months of July through September, when the adult bees are most active,

is extremely variable. Heavy rains and overcast days were common during the early part of the 1954 season. However, this species appears to adjust to all but the most severe weather conditions and, as was noted earlier, will gather pollen even during light rain. Heavy rains cause the bees to return to their burrows where they remain just inside, facing the entrance. In the face of very heavy rainfall the females retreat down the burrow, turn around and back up to the entrance and block it with the abdomen. This activity pattern, together with the erect turret may have a high survival value for the species in an area where torrential cloudbursts may cause floods which, however, are of short duration. However, the use of water in excavation also indicates adaptation to the drier conditions which prevailed at other times.

Flower relationships. As with all oligolectic bees, the flower relationships are particularly critical. These include not only the phenological relationship between the bee and the pollen plant, but, in addition, competition with other insect species for the pollen and nectar.

Ipomoea longifolia Benth. was the most abundant species of morning-glory in the areas studied and the only pollen source utilized by *P. sumichrasti* during the first portion of the season. House (1908) records distribution of this plant as from Oklahoma and Texas to Arizona and south into Mexico to Queretaro in Baja California and to Aguas Calientes in Central Mexico. The species is characterized, in part, by having trailing stems up to 10 feet long; elongate, narrow, entire leaves, and large, white, pink-throated corollas. The flowers, according to our observations, open in the early morning, usually shortly before sunrise, and last but a single day. At the site north of Fresnillo, in mid-July, individual plants were producing from a few to a dozen flowers each day. At the same time, there were some almost mature fruits on several plants. On August 6, 1.5 miles south of Fresnillo, very few flowers were opening each day although the bloom in this area had been judged as comparable to the other when both areas were seen in mid-July. On the later date a survey was made of the *Ipomoea* plants in a triangular area of approximately 7500 square feet. There were 44 plants of *I. longifolia* and 19 plants of *I. pringlei*. The *longifolia* plants were classified for each of the following characteristics: maximum diameter of plant, opposite diameter, number of maturing fruits, number of old flowers that had failed to produce fruits and had fallen from plants, number of old flowers which were presumably from the previous day, number of new flowers, and, finally, the number of buds. These data are revealing in a number of particulars. First, 14 of the smaller and presumably youngest plants had not produced any floral parts. The other 30

plants exhibited a wide range of size and productivity. To summarize, 16 or approximately 53 percent of these plants had a potential productivity of 14 to 95 flowers and a total of 730 blooms or 13 per cent of the total flower production (5665) of the 30 plants; 8 or 27 per cent had 118 to 274 flowers and a total of 1486 flowers or 26 per cent of the total while the remaining 6 plants or 20 per cent had 355 to 885 flowers and a total of 3449 flowers or 63 per cent of the total. The latter statistics clearly show the dependence of *P. sumichrasti* in this area on a relatively small number of plant individuals. On the day of the survey there were only 15 new flowers in the survey area, 18 wilted flowers from the previous day, and 190 buds, all of which were associated with eleven of the thirty plants. Thus it seems reasonable to assume that this plant species would have been available to the bees for approximately two weeks more. However, at this same time, the second species of *Ipomoea, I. pringlei,* was in an early blooming stage and was being visited by considerable numbers of bees.

Ipomoea pringlei Gray was abundant in only one of the three areas studied but was visited by *P. sumichrasti* in all three localities. The distribution of this plant, according to House (1908) and H. K. Sharsmith (*in litt.*), is considerably less than that of *I. longifolia* being known from the States of Chihuahua, Coahuila, Durango, and Zacatecas in Mexico. The most northern of these records is Santa Clara Canyon in Chihuahua; the southernmost is 9 miles south of Fresnillo in Zacatecas. This species is a low, dense bush, 2 to 4 feet tall with erect, green branches, the leaves are pinnately divided into filiform divisions, and the corolla is reddish-purple with a white center. In the *Ipomoea* survey area, (referred to above) only 8 of the 19 plants had started blooming but all of them had large numbers of buds in many stages of development. Only a single maturing fruit was found. Unfortunately, the erect and dense growth characteristics did not permit recording figures comparable to those taken for *I. longifolia.* However, the plant which had a maturing fruit also had 15 old flowers, 27 new flowers and more than 35 buds. This was by far the most advanced plant, and the maximum number of new flowers on any other plant was 6. The time at which flowers of this species opened is approximately the same as for *I. longifolia* but it was not positively established whether flowers survived more than one day.

A number of other insect species were competing with *P. sumichrasti* for the pollen of both species of *Ipomoea.* The more significant of these were the several kinds of lepidopterous larvae which were abundant in mid-July; an emphorine bee, *Melitoma euglossoides* Lepeletier and Serville; a scarab beetle, *Euphoria*

basalis Gory and Perch[8]; and a blister beetle, *Lytta variabilis* Dugés. The scarab was abundant in all areas where *Ptilothrix* was studied. *Melitoma* was most numerous in the locality 1.5 miles south of Fresnillo. The nature of the competition furnished by these two insects and the apparent reasons for the relative abundance of *M. euglossoides* are discussed below.

Euphoria basalis is a common cetonid in Central Mexico. Casey (1915) states that it is abundant from Durango to Mexico City, and Sallé (1833) reports its association with squash flowers. We found this beetle in Cucurbita flowers at several localities, but not as abundantly as in the blossoms of *Ipomoea longifolia* and *I. pringlei*, where up to six individuals occurred in a single flower. Shortly after the opening of new flowers each morning the scarabs enter them, remain eating the floral parts throughout the day, and spend the night within the wilted blossom. On clear mornings the bees undoubtedly gather their pollen before the beetles transfer to the new flowers, but on overcast or rainy mornings, the beetles may invade and destroy the pollen before the bees can gather it. It is possible that the fact that only half of the flowers in the survey area produced fruits may reflect the activity of *Euphoria* and other less common insects of similar habit. However, it is likely that a large percentage of damaged flowers would have been visited by *Ptilothrix sumichrasti* or *Melitoma euglossoides* before being injured.

Melitoma euglossoides was the only other bee species observed in *Ipomoea* flowers and unquestionably it competes with *P. sumichrasti* for available pollen. It has a much wider distribution than *P. sumichrasti* and was found in all areas where the latter species occurred. Like *Ptilothrix,* it gathers pollen only from *Ipomoea,* but we found it associated with a greater number of species of this plant. In contrast to *P. sumichrasti,* this bee nests only in vertical surfaces, such as banks or adobe dwellings, and forages over greater distances for water and pollen. The relative abundance of these two species is apparently controlled by the availability of suitable nesting sites. Wherever adequate sites for both species occurred, *M. euglossoides* was the dominant species. For example, 17 miles north of Fresnillo the only bank was a small one formed by the construction of a drainage culvert under the highway, although there were extensive areas of bare, flat or gently sloping, ground. Here the proportion of the two species was about 10 to 1 in favor of *Ptilothrix*. The opposite was true 1.5 miles south of Fresnillo where there were both extensive banks on both sides of a stream bed and large areas of flat, barren ground. Thus it would appear that the num-

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[8] Identified by L. W. Saylor.

bers of *P. sumichrasti* are influenced not only by its own requirements but by the presence or absence of suitable nesting sites for *M. euglossoides*.

Parasites and predators. Two entomophagous species of insects were associated with the cells of *P. sumichrasti* in the Fresnillo area. One was the meloid beetle, *Lytta variabilis* Dugés, of which an unemerged adult was captured in its resting cell adjacent to the destroyed cell of *P. sumichrasti* from the previous year. However, further excavation of old burrows did not yield many cells which had been destroyed by *Lytta* nor were the beetles numerous in any of the three sites although present at all of them.

Indirect evidence suggests that an undetermined species of Bomyliidae destroys a greater percentage of the immature bees than does *Lytta variabilis.* The bombyliid larvae were found in some cells, shed pupal skins were observed projecting from many old burrows, and adults were seen ovipositing in burrows of the current season.

It is likely that *Ptilothrix*, through the development of such characteristics as a solitary nesting habit, the construction by the female of several burrows with only a few cells each, and possibly also the production of a turret at the entrance, has reduced the influence of parasites and predators. These adaptations, on the other hand, have probably reduced the reproductive potential of the species.

GENERIC BIOLOGICAL CHARACTERS AMONG EMPHORINE BEES

We have called attention previously (Linsley, MacSwain and Smith, 1952a) to some of the biological generic characters among emphorine bees[9]. Some of these may now be supplemented and all are summarized below. No features are known to us to suggest that *Ptilothrix* and *Emphor* are generically distinct on biological grounds. (Moure, 1947, apparently reached much the same conclusion on morphological grounds.) *P. sumichrasti* collects pollen from *Ipomoea* (Convolvulaceae) and *Tmphor bombiformis* from *Hibiscus* (Malvaceae), but judging from the situation in *Diadasia* this would appear to be a specific character.

[9] For discussions of morphological generic characters among the Emphorinae, see Michener (1944, 1954).

In all other features mentioned below the two species are essentionally identical[10].

Nesting situation. *Ptilothrix sumichrasti* (and *Emphor*) generally prefer flat, hard-packed ground, devoid of vegetation. *Diadasia* species usually select flat, moderately well-packed ground, adjacent to sparsely placed vegetation. *Melitoma* utilizes cliffs and vertical banks (including soil blocks in uprooted trees). This characteristic is a specific rather than a generic feature in *Anthophora* and may prove to be so here.

Use of water in excavation. *Ptilothrix, Emphor* and *Melitoma* regularly collect water to moisten the soil during excavation of the burrows; *Diadasia* species do not. *Ptilothrix* (and *Emphor*) alight on the surface of ponds, well out from the margin. *Melitoma* species also gather water from the surface but alight near to the land and are most commonly observed along the margins of running water.

Excavated materials. The material excavated by *Ptilothrix* (and *Emphor*) and *Melitoma* during burrow excavation is in the form of mud pellets which are kicked out of the turret opening. In *Diadasia* loose soil is pushed out as a tumulus or carried and dropped at a distance from the nest.

Turrets. *Ptilothrix, Emphor* and *Melitoma* construct turrets with the first soil excavated. In *Ptilothrix* (and *Emphor*) the turrets are vertical, short, entire and symmetrical; in *Melitoma,* elongate, curved, split. The species of *Diadasia* build their turret more slowly and do not appear to initiate it with the first earth excavated. The turret in this case is elongate and entire and may be straight or curved. *Ptilothrix* (and *Emphor*) break down the turret and use it to seal the completed, provisioned burrow.

Burrow shaft and cells. The burrow shaft of *Ptilothrix* (and *Emphor*) is shallow and vertical, with few cells; of *Melitoma,* more or less horizontal, with many cells; of *Diadasia,* vertical, straight or sinuous, with many cells. In *Ptilothrix* (and *Emphor*) the cells are arranged singly; in *Melitoma* and *Diadasia* they are arranged serially.

Pollen flowers. The Emphorinae as a group exhibit a high degree of oligolecty at the generic and specific levels. However, *Emphor, Ptilothrix* and *Melitoma* visit large deep-flowered malvaceous or convolvulaceous plants (*Hibiscus, Ipomoea,* and *Ipomoea* respectively), *Diadasia* mostly but not exclusively smaller flowered or shallower flowered plants, such as *Sphaeralcea, Sidalcea, Sida.*

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[10] These generalizations are based upon relatively complete data for one species each of *Ptilothrix* and *Emphor*, two of *Melitoma*, and eight of *Diadasia*. Less extensive data available for other species are in agreement.

SUBFAMILY BIOLOGICAL CHARACTERS OF EMPHORINE BEES

Information now available makes possible certain tentative comparisons between the biological characters of the Emphorinae[11], Anthophorinae and Eucerinae[12]. Sufficient data are not now available to us to permit comparison with the Exomalopsinae or Hemisiinae.

Turrets. Turrets are characteristic of the active nests of all of the Emphorine bees which we have studied, although in *Diadasia* they are sometimes blown or washed away. Among the anthophorine bees, some species construct turrets, some do not, although in our experience the habit is less prevalent than many writers appear to have believed. We have not found turrets at the entrance of the burrow of any North American eucerine bee but they have been reported for the European *Eucera* (Friese, 1923).

Cells. The cells are arranged serially in the Anthophorinae, serially or singly in the Emphorinae, and apparently always singly in the Eucerinae. The external shape is urn-like in the Emphorinae and Anthophorinae, elongate-oval in the Eucerinae. The water-proof lining is thick in the Anthophorinae, thin in the Eucerinae, and very thin or lacking in the Emphorinae. In the Anthophorinae the inside of the cap is also lined, not so in the Eucerinae and Emphorinae.

Cell provisions. The Emphorinae provision their cells with a dry convex pollen mass, the Eucerinae with very moist pollen (*Eucera* is said to work the food material into a ball, our genera pack the pollen into the base of the cell and cover it with a thin layer of nectar, which may be mixed partially with the surface pollen), and the Anthophorinae with pollen topped with liquid (concentrated nectar?). In this last group the cells have a characteristic strong fermenting odor not evident in those of the Emphorinae or Eucerinae.

Position of egg. The eucerine bees insert or float their eggs on the top of the pollen mass, the anthophorines float them on a surface liquid, and the emphorines place them beneath a pollen mass.

Larval feeding. In the Anthophorinae and Eucerinae the larvae feed from the top of the food mass; in the Emphorinae

[11] See also Linsley, MacSwain and Smith, 1952a.
[12] See also Linsley, MacSwain and Smith, 1956.

the slender larvae are very active and continually move around the pollen mass while feeding.

Disposition of fecal material. The mature larvae of the Anthophorinae deposit their fecal material in semi-liquid form at the bottom of the cell. The same is said to be true of the European *Eucera* but the eucerines known to us plaster it at the top of the cell (Linsley, MacSwain and Smith, 1956). In the Emphorinae it is deposited over the entire inner surface of the cell.

Cocoon. The anthophorine bees construct no cocoon. The emphorines cover the plastered fecal material with a thin, varnish-like layer. The Eucerinae construct a conspicuous, double or multi-layered cocoon. It is interesting to note that the parasitic bees of the genus *Xeromelecta* construct a cocoon similar to that of the emphorines and that the position of the anal opening of the larva and sclerotization of the surrounding area is also similar. It might be worthwhile to re-examine the morphology of the adults in the light of this suggested relationship.

Pollen preferences. The Anthophorinae are polylectic at the subfamily and generic levels, mostly so at the species level. The Eucerinae are mostly oligolectic at the species level, although within the subfamily many groups of plants are utilized as pollen sources. The Emphorinae show a strong preference for the plant families Malvaceae and Convolvulaceae and the proportion of oligolectic species is very high.

Gregarious nesting tendencies. In our exeperience the eucerine bees exhibit no tendencies toward gregarious nesting[13], although apparently Thygates nests in dense aggregations (Michener, *in Litt.*). In the Emphorinae the tendency is slight, except in *Melitoma*, in which it appears to be well developed. Among the Anthophorinae, gregarious nesting appears to be characteristic of a large proportion of the species.

BIOLOGICAL CHARACTERS OF THE ANTHOPHORIDAE

There are a number of reasons for considering the Anthophoridae as a family distinct from the other groups with which it has recently been combined. Two which we have not seen emphasized previously are (1) the Anthophoridae overwinter

[13] The question as to whether the tendency to concentrate a large number of burrows in a limited area is an inherited characteristic, or reflects environmental limitations, or is a matter of chance, remains to be resolved. In any event, differences between species are evident in this respect.

in the larval stage, in contrast to the Apidae (including the Bombinae and Meliponinae) and the Xylocopidae (including the Ceratininae), and (2) with the exception of *Clisodon,* they nest in the ground and the non-parasitic forms construct their own burrows (except possibly *Exomalopsis*). Some of the social bees nest in the ground but they utilize existing cavities.

SUMMARY AND CONCLUSIONS

(1) *Ptilothrix sumichrasti* (Cresson) nests non-gregariously in flat or gently sloping, hard-packed, barren soil in areas where water and *Ipomoea* are both available. Water is utilized in excavation and in order to collect it they alight directly on the surface. The burrow is shallow (65-115 mm.), vertical, with a very short turret. The soil is excavated in the form of moist pellets which are thrown out of the entrance by the hind legs. The first cell is constructed at the bottom of the main shaft, others to the side and slightly below the first. They are externally urn-shaped, vertical, separate, and vary from one to five in number. The pollen mass is cup-shaped but convex above, dry, and is placed on top of the egg. The larva feeds by cutting channels around the pollen mass reducing it to a successively smaller sphere as feeding progresses. When larval development is complete, feces are plastered on the wall of the cell and a thin papery cocoon is constructed within. Adults are active over an extended period in the summer. They apparently construct and provision several burrows.

(2) *Ptilothrix sumichrasti* (Cresson) and *Emphor bombiformis* (Cresson) exhibit very similar nesting habits. On the basis of information now available there appear to be no biological grounds for assigning them to different genera.

(3) The genera of Emphorinae exhibit differences in the use of water in excavation, the form of the excavated material, in turret formation, in the pattern of the burrow shaft and cell arrangement, and in pollen sources.

(4) The subfamily Emphorinae appears to be amply distinct from the Anthophorinae and Eucerinae on biological grounds. Comparisons with the Exomalopsinae and Hemisiinae await additional data. Biological features of the melectine genus *Xeromelecta* suggest a possible relationship with the Emphorinae that should be further explored.

(5) The Anthophoridae exhibit a biological unity and distinctness from related groups of bees which we interpret as justifying recognition at the family level.

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NOTES ON THE LIFE HISTORY OF A RARE ARIZONA SPHINX MOTH, *XYLOPHANES FALCO* WALKER

By John Adams Comstock

One of the prizes that occasionally falls to the net of the lepidopterist in southern Arizona is *Xylophanes falco* Wlk.

This moth is not illustrated in any work dealing with the lepidoptera of the United States, and apparently nothing has been published on its life history.

It is included by Druce in Biologia Centrali-Americana[1] and pictured in color. Its habitat is given as Mexico to Honduras.

Draudt also includes it in Seitz[2], giving its range as "Mexico to Honduras and Guatemala," and showing an excellent figure on Plate 98 E.

In the Dyar Catalogue of 1902[3] it is not included, but in 1927 Barnes and Benjamin list it for boreal America[4].

My first sight of it on the wing was in the Chiricahua Mountains of Arizona, several years ago, when the late John and Grace Sperry and I were camped in Barfoot Park, and discovered this rarity sipping nectar from the blossoms of wild *Iris*. Since then I have taken it at light in Madera Canyon, Santa Rita Mountains, Arizona, but always sparingly. Incidentally, this canyon seems to be one of the outstanding spots in the southwest, for sphinges. Lloyd Martin reports that the Los Angeles Museum collection has a total of twenty-one different species of sphinx moths taken within the confines of Madera Canyon, an area less than three miles long.

During a collecting trip to the Santa Rita Mountains in 1946 I collected larvae of two different species of sphinges.

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[1] Druce, H. Biol. Cent. Am. 1: p. 12, pl. 1, fig. 8. 1900

[2] Draudt, M. Seitz Macrolep, of the World. VI. Americana, p. 890.

[3] Dyar, Harrison G. Bull. U. S. Nat. Mus. No. 52. A. List of No. Am. Lepid. 1902.

[4] Barnes, Wm. and Foster H. Benjamin. Check List of the Lepid. of Boreal Am. Superf. Sphingoidea, Saturnioidea and Bombycoidea. Bull. So. Cal. Ac. Sci. 26: (2) pp. 35-50. 1927.

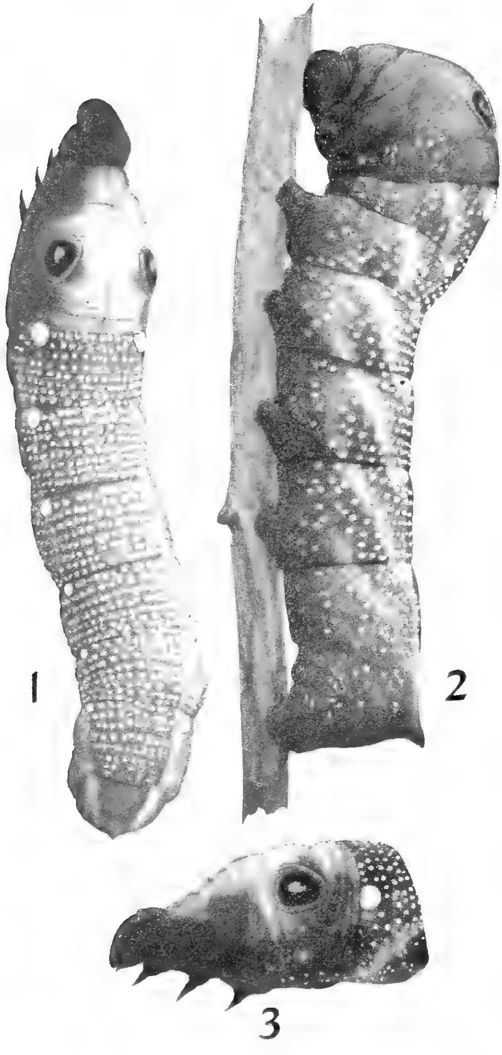

PLATE 27

Larva of *Xylophanes falco* Walker.

Fig. 1. Dorsal aspect. Fig. 2. Lateral aspect. Fig. 3. Head, and first five segments of larva, lateral aspect. All figures slightly enlarged. Photographs, courtesy of Henry Wilson.

One lot, reared on *Boerhaavia*, emerged in July and August of 1947, and proved to be *Arctonotus terlootii* Hy. Edw., the life history of which was published in 1948[5].

The second species, a single larva, was feeding on *Bouvardia glaberrima* Engelm. Notes were made of this, but the specimen proved to be parasitized, so we could not attach a name.

On August 5, 1947 John S. Adams collected one example of the same type of larva in Madera Canyon, altitude about 5500 feet, and Bernie Weber secured two more in the same locality on September 13, 1947. In both cases the foodplant was reported as a species of "wild honeysuckle." Photographs of the mature larva were made by Henry Wilson. Later, a pupa was made available, and one of these, under the watchful eye of William A. Reese, produced an imago of *Xylophanes falco.*

It will be noted that a number of persons cooperated in furnishing the material and developing the facts that have made possible this account of a new life history.

These individuals belong to a group of younger entomologists whose interest was aroused and stimulated by the several educational agencies operating under the aegis of the Division of Science of the Los Angeles County Museum, and the Lorquin Entomological Society. To these young men, our thanks are due for the materials and facts that have made it possible to present the following data.

Xylophanes falco Walker

Mature larva. Length, extended, 77 mm. Body thickest through fourth segment, tapering gradually towards cauda.

Head and first segment small and retractile, being drawn partly into the third and fourth segments when resting.

The head and all of its appendages except the clypeus are black. The latter is a dull blackish ivory.

Body ground color, predominately smoky black. There is a narrow black mid-dorsal stripe running from the first to the fifth segments, lateral to which is a dull ivory area dorsally, gradually changing to black dorso-laterally.

The fourth segment bears two conspicuous round eye-like spots lateral to the dull ivory area. Both of these have a centrally placed blue pupil in the form of a circlet, or a letter C, resting on a velvety black background. The black spot is circled by a narrow yellow band, which in turn is circled by a narrow

[5] Comstock, J. A. Bull. So. Calif. Ac. Sci. 47: (2) 49-51. 1948.

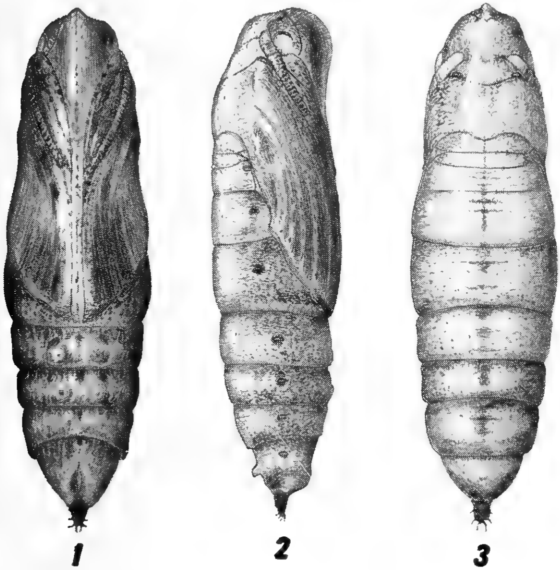

PLATE 28

Pupa of *Xylophanes falco* Walker.

Fig. 1. Ventral aspect. Fig. 2. Lateral aspect. Fig. 3. Dorsal aspect. All figures slightly enlarged. Reproduced from painting by the author.

black stripe. The whole effect gives the appearance of a large, widely opened eye, particularly when the segment on which it rests is bulged by the retraction of the head.

There are two longitudinal rows of large round or oval white spots in line with the large ocellar spots, which are paired on each segment from the sixth to the eleventh segments.

Each of these spots is placed immediately caudad to a segmental juncture.

A series of diagonal bands is present on the lateral surface. Each of these begins at one of the round white spots just men-

tioned, and runs antero-inferiorly. These bands are a soiled ivory, and their margins are not clearly delimited.

The spiracles are placed on the antero-superior margins of these diagonal bands, except for those which occur on segments where the diagonals are absent.

From the sixth to the eleventh segments the body is crossed transversely by lines of fine white dots which run in parallel series of approximately eight rows to a segment.

The caudal horn is stout, short, and slightly recurved caudally. It is black, as are also the legs, prolegs and crochets.

The abdominal surface is predominantly dull slaty black.

Spiracles, soiled ivory, the centers shaded with black, and a fine black circlet around the margins.

The larva is illustrated on Plate 27.

Pupa. Length, 46 mm. Greatest width, 14 mm. Robust, tapering gradually toward the rounded head, and more acutely toward the cauda.

Color, light tan or straw, with sparse smoky black and brown markings and mottlings.

The texture of surfaces of the thoracic portions and the wing cases is smooth and glistening; that of the remaining surfaces delicately rugose or punctate, hence dull.

The wing cases are somewhat heavily marked with brownish black, except for their costal margins, which are very light brown, with a few round black spots conspicuously placed on them. The antennae reach only half the distance to the margins of the wings.

The caudal horn of the larva persists as a small button, inclining slightly caudad. The black cremaster is short and stubby, and bears a few short, slightly curved spurs.

The spiracles are black rimmed, and prominent. No setae or tubercles occur on any portion of the body.

Other structural characters not specifically mentioned are shown on the illustration, Plate 28.

SCHIZASTER MORLINI, A NEW SPECIES OF ECHINOID FROM THE PLIOCENE OF IMPERIAL COUNTY, CALIFORNIA

By U. S. Grant, IV[1], and Leo George Hertlein[2]

In March, 1955, Dr. G. Dallas Hanna, Curator of the Department of Geology, California Academy of Sciences, received from Mr. W. Morlin Childers of El Centro, California, a letter accompanied by specimens and photographs of a fossil echinoid found at Coyote Mountain, Imperial County, California. Mr. Childers mentioned that the specimens resembled *Schizaster martinezensis* Kew, but he recognized that differences existed between the two and suspected that his specimen might represent an undescribed species.

The specimens were submitted to the junior author for identification and it became evident that they represented an undescribed species. Further correspondence between Hanna and Childers led to a request that the present authors study and describe the species. Four specimens have been available for this study.

The authors wish to thank Mr. Childers and Dr. Hanna for the opportunity to study and describe this interesting new species, the first species of *Schizaster* from Post-Eocene beds in southern California.

Schizaster morlini new species

Plate 29, Figures 1-8

Test broad, oval, greatest width at about the middle of the length and anterior to the apical system; greatest height at interambulacrum 5, which is keel-shaped; posterior high, vertical, somewhat concave around a large periproct; actinal surface slightly convex, labrum prominent with peristome wide, somewhat

[1]Professor, Department of Geology, University of California at Los Angeles.

[2]Associate Curator, Department of Geology, California Academy of Sciences, San Francisco.

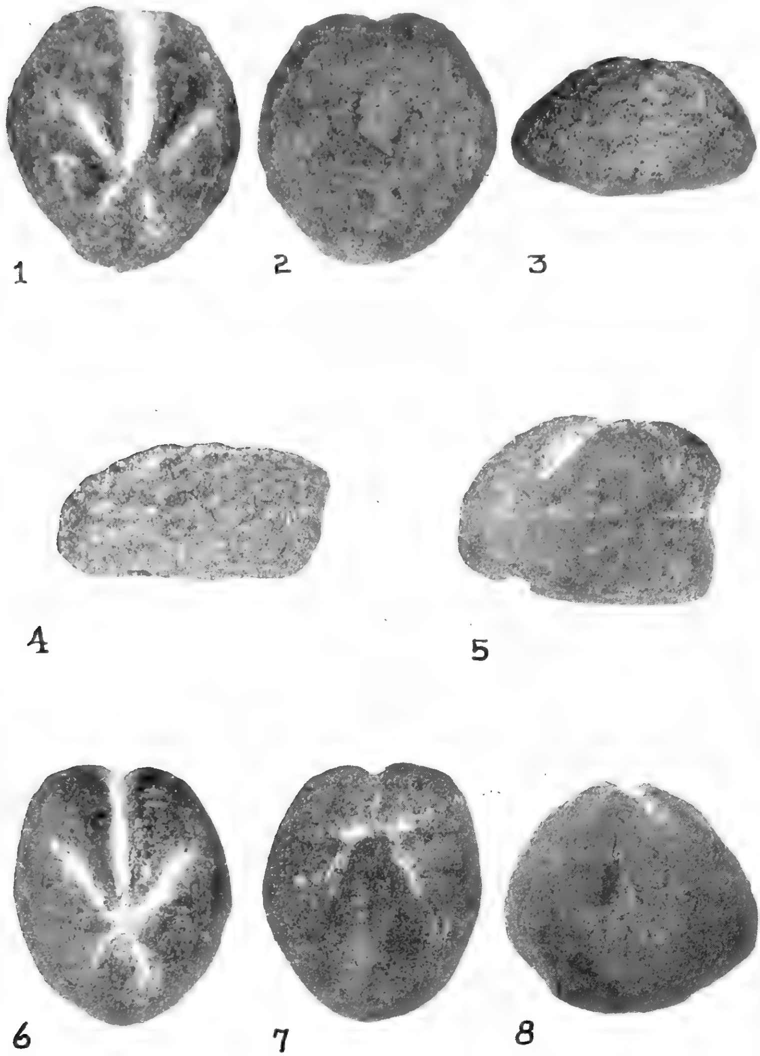

PLATE 29

Figs. 1-8. *Schizaster morlini* Grant & Hertlein, new species. Holotype, length 54 mm.; width, 49.5 mm.; height, 24 mm. Fig. 1. Abactinal view. Fig. 2. Actinal view. Fig. 3. Posterior end view. Fig. 4. Lateral view. Paratype, length, 35 mm.; width, 29.5 mm.; height, 26 mm. Fig. 5. Lateral view. Fig 6. Abactinal view. Fig. 7. Actinal view. Fig. 9. Posterior end view. The original shape of the specimens has been altered somewhat due to compaction of the enclosing sediment.

sunken; all petals sunken, particularly the anterior unpaired III, which has vertical walls and extends to anterior ambitus; posterior paired ambulacra, I and V, short, not extended to the margin of the test; fascioles indistinct and incomplete, apparently due to lack of preservation; genital pores obscured. Measurements of holotype: anterior-posterior length 54 mm.; width 49.5 mm.; height 24 mm. Measurements of paratype: length 35 mm.; width 29.5 mm.; height 26 mm.

Holotype and Paratype (Calif. Acad. Sci. Dept. Geology Type Coll.) from the southern slope, approximately midway east to west about two thirds of the way to the top of Coyote Mountain, Imperial County, California, in a sandstone formation; Pliocene. Specimens of a coral, *Eusmilia carrizoensis* Vaughan, were found at approximately the same locality.

This new species differs from *Schizaster cristatus* Jackson (1917, p. 499, pl. 68, figs. 2-4), from the "Upper Oligocene or Miocene" of Brazil, Costa Rica, in its less prominently raised keel in interambulacrum 5, the narrower and more steep-sided ambulacrum III, and the larger angle between the posterior paired ambulacra. *Schizaster morlini* n. sp. differs from *S. panamensis* Jackson (1917, p. 500, pl. 66, figs. 2-3) of the Gatun formation, Canal Zone, in the more deeply sunken petals and wider bivaial angle. The new species here described differs from *Schizaster stalderi* Weaver (1908, p. 274, pl. 21, fig. 3) in the more depressed unpaired anterior ambulacrum, the narrower space between the bivium, the more elevated keel in interambulacrum 5, and in the less anterior position of the peristome. Weaver's species occurs in Pliocene strata at the mouth of Bear River, Humboldt County, California, but has not been authoritatively reported in the southern part of the state.

This new species is named for Mr. W. Morlin Childers, El Centro, California, who collected the type specimen.

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TWO NEW SPECIES OF NASSARIUS FROM THE PLIOCENE OF LOS ANGELES COUNTY, CALIFORNIA

By George P. Kanakoff

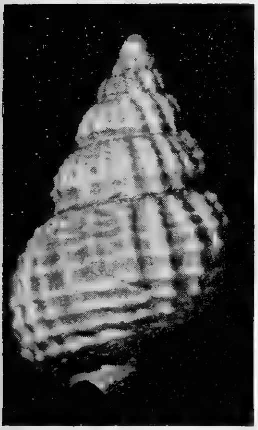
In May, 1954, the author reported a new *Kelletia* from the Upper Pliocene of the Pico Formation from Humphreys Quadrangle in Los Angeles County[1]. During the following months the several tons of silt collected from the locality yielded a large marine fauna in a good state of preservation. The lumps of matrix, ranging from almost black to light gray in color and from silt to shale in consistency, had first to be dried, then soaked in sieves half-submerged in water to separate the shell material from the matrix. When again dried so that the shell material was hard enough to handle, the specimens were sorted and studied.

Among the forms segregated are two new species of *Nassarius,* one very abundant, the other comparatively rare. These are the subject of the present paper.

Nassarius stocki sp. nov.

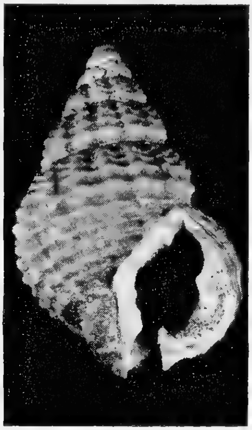
Holotype: The holotype No. 1109 in the Los Angeles County Museum (Pl. 30, figs. A and C), collected by the author, May 10, 1954.

[1]Kanakoff, G. P., 1954, Bull. So. Calif. Acad. Sci. V. 53, pl. 2, pp. 114-117.



A.

B.



C.

PLATE 30.

Nassarius stocki sp. nov.
Holotype L.A. County Museum #1109—"A" and "C."
Paratype L.A. C. M. (a longitudinal section—"B."

TYPE LOCALITY: LACMIP 291 (Los Angeles County Museum, Invertebrate Paleontology, Locality 291). An exposed stratum of black silt, weathering into gray, in a gully in the center of the south half of Sec. 27, T. 4N, R. 15W, Mt. San Bernardino B. and M., (which is probably the same as Kew's Loc. No. 3590)[2]; it is exactly ½ mile south of the Humphreys RR Station, Los Angeles County, Calif.

AGE AND FORMATION: Upper Pliocene, Pico formation.

DIAGNOSIS: Shell small for the genus, ovate-conical; whorls seven, convex, strongly cancellated by prominent axail ribs (sloping posteriorly at 5 degrees to the axis of the shell) and overlying (less prominent) thinner ridges, together forming squarish concave interspaces on the last five whorls; spire acuminated at an angle of 62 degrees; sutures deep, sharply defined; the body whorl with 15 ribs, the sixth whorl with 19, the fifth with 16, the fourth with 16, the third with 14 obsolete riblets, and the first two whorls

[2]Kew, W.S.W., USGS Bull. 753, pp. 77-81.

bare, forming a simple smooth nucleus; inner lip thin, reflected, with four prominent parietal bar-like tubercles, forming upper and lower pairs; outer lip thick (with an inner thickening resembling an internal varix) with one prominent tooth in the middle and three lesser bar-like tubercles, one above and two below it; columella extended, with a strong plication on the inner side, and a deep, narrow groove, around it at the base of the body whorl. The holotype, a large adult, measures: length 9.6 mm., breadth 5.5 mm. The holotype has the outer lip interiorly extended by an elongated tubercle which deepens the canal (See Pl. 30 fig. C); sectioned paratype No. 142 shows the tubercle to be continuous with the columella.

Paratypes: Out of 500 plus specimens of the species available, 130 near-perfect adults were selected and measured. A longitudinal section of one (L.A. Co. Mus. No. 142) is figured (pl. 30, fig. B).

Absolute means of the measurements of the paratype lot are:

1. length—7.282 mm.
2. width—4.581 mm.
3. ratio length to width—1.589.

Distribution: Known only from the type locality.

DISCUSSION

The striking feature of this lot is the uniformity of this small species, where the general shape and sculpture are concerned. The most variable feature noticed is the number of denticles in the aperture, varying from strongly serrate to obsoletely serrate, and from 2 to 8 denticles in the outer lip.

This species is named for one of the most highly honored and foremost paleontologists of the United States, who in addition to his scientific achievements was also outstanding for his qualities as a human being, Dr. Chester Stock (1892-1950), under whose guidance the author had the privilege of working for over eleven years.

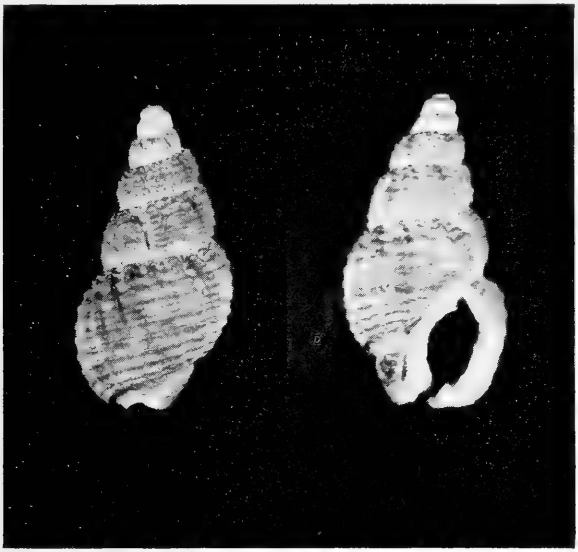


PLATE 31

Nassarius hildegardae sp. nov. Holotype L.A. Co. Museum #1110

Nassarius hildegardae sp. nov.

Holotype: The holotype No. 1110 in the Los Angeles County Museum collected by the author May 10, 1954 (pl. 31).

Type Locality: LACMIP 291.

Age and Formation: Upper Pliocene, Pico formation.

Diagnosis: Shell smallest in the genus, elongate-conic; whorls seven, flattened-convex, four of them with rugosely cancellated sculpture; ribs 12 on the fourth whorl, 13 on the fifth, 15 on the sixth and 16 on the body whorl, crossed by overlying thinner, raised uniform spiral ridges; 4 on the fourth whorl, 6 on the fifth whorl, 5 on the sixth, and 8 on the body whorl, forming bead-like effect on the crossing, and rhomboid cavities in the interspaces; spire acuminated at 40 degrees; first three whorls bare, forming a simple, smooth nucleus; sutures deeply incised; aperture narrowly-oval, its axis at 25 degrees to the axis of the shell; inner lip thick, reflected, free, with 2 bar-like tubercles at the anterior end, and 3 round tubercles at the posterior end; outer lip thick, with 6 bar-like tubercles evenly spaced throughout its inner length; canal short, broad; siphonal notch profound. The holotype, a large adult, measures: length 9.2 mm., breadth 4.0 mm., and length of the aperture (canals included) 3.2 mm.

PARATYPES: Out of 70 plus specimens, 44 adults in a good state of preservation were selected and measured. Slight variations were noticed in the thickness of the outer and inner lips, which range from almost-smooth to strongly serrated, and the inner lip from thin and attached, to thick and detached, the denticles on it ranging from 2 to 6 in number; in all other respects exteriorly being very uniform.

Absolute means of measurements of the paratype lot are:

1. length—5.604 mm.
2. width—3.014 mm.
3. ratio length to width—1.859.

DISTRIBUTION: Known only from the type locality.

DISCUSSION

At a glance, this species resembles young specimens of *Nassarius mendicus* Gould, but differs in size, more acuminated spire, sculpture, and in the shape of the aperture, both lips being proportionately much thicker in this species.

Nassarius hildegardae is named for the noted avian paleontologist, Dr. Hildegarde Howard, Chief Curator, Division of Science, Los Angeles County Museum, who has given so willingly and unstintingly of her time, knowledge, and friendship to the author, and whose help and many years of pleasant association are gratefully acknowledged.

A NEW HOST AND LOCALITY RECORD FOR IXODES JELLISONI COOLEY AND KOHLS

A single specimen of *Ixodes jellisoni* was taken from the neck of a kangaroo rat *Dipodomys agilis agilis*, collected December 19, 1955, in Loma Linda, San Bernardino County, California. The rat and tick were collected by M. J. Whitney who very kindly gave them to the writer.

Cooley and Kohls (1945) list previous collections of *I jellisoni* from a ground squirrel, Kings County, California, and from several *Perognathus californicus*, (pocket mouse), from Alameda and Monterey Counties, California. This is the first record of this tick from a kangaroo rat and the first time it has been reported from San Bernardino County.

Acknowledgment is hereby given for the kindness shown by Dr. Glen M. Kohls, Rocky Mountain Laboratory, who identified the tick, and to Dr. Robert T. Orr, California Academy of Sciences, who identified the kangaroo rat. The tick has been deposited in the museum of the California Academy of Sciences.

LITERATURE CITED

Cooley, R. A. and Glen M. Kohls
1945. The genus *Ixodes* in North America. Nat. Inst. of Health Bull. No. 184

Robert D. Lee
Department of Entomology, School of Tropical and Preventive Medicine
College of Medical Evangelists, Loma Linda, California

THE LARVA OF *Euclidimera diagonalis* Dyar, (Lepidoptera; Catocalinae)

Three species of the genus *Euclidimera* are listed for North America, north of Mexico in the McDunnough Check List (1938)[1], namely – *E. intercalaris* Grt., *E. diagonalis* Dyar, and *E. triangulata* B. & McD.

Apparently no records of the early stages of any member of the genus have been published.

On August 15, 1954, I collected a single larva in Ramsay Canyon, Huachuca Mountains, Arizona. It was found in the evening, resting on grass, and apparently had finished its feeding period, as shortly thereafter it began spinning a fragile cocoon.

Fortunately, I had made field notes before the process of cocoon making began.

The site chosen for pupation was near the ground, among stems of grass, and small particles of vegetation were incorporated into the cocoon, resulting in a good camouflage.

With only a single example of an apparently unknown species to work with, the pupa was purposely left undisturbed.

In just three days short of one year (August 12, 1955) a typical example of *Euclidimera diagonalis* (Dyar) emerged.

My field notes were subsequently slightly damaged by rain, but the following items were salvaged:

Mature larva. Length, 39 mm. Subcylindrical, tapering slightly toward head and cauda.

Head, larger than first segment, prominently striped with light brown and white lines running vertically. Ocelli, black. Antennae, white. Mandibles irregularly edged with black.

Body, striped longitudinally with dark and light bands. These bands are composed of numerous fine wavy lines.

The middorsal band is made up of four dark elements on a ground of yellowish straw.

[1]McDunnough, J., Check List of the Lepidopt. of Canada and the U.S. of America. Part 1, Macrolep. Memoirs, S. Calif. Acad. Sci., Vol. 1. 1938.

The dorso-lateral band is composed of five red-brown wavy stripes on a ground of light olive.

The suprastigmatal band is composed of a variable number of salmon colored elements on a ground of light straw.

The stigmatal band is divided into an upper half of four light brown elements on a ground of light olive, and a lower element of a crenulated band of salmon, below which is a band of white.

Inferior to this is a band composed of three or four black lines. My notes on the ground color of this band were blurred by rain.

Below this is a pinkish-salmon area.

The abdominal surface is covered by numerous delicate brown lines on a straw colored base.

Spiracles, pinkish, rimmed with black. Legs, translucent straw.

There are three pairs of prolegs, counting the anal pair. The typical proleg is mottled light pink and brown, and has a large black tubercle laterally placed on it.

The larval pattern is somewhat like that described by Forbes (1954)[2] for a closely related group,—*Euclidia*, but the colors are brighter and more varied. One member of this genus, *E. cuspidea* Hbn., a common eastern species, feeds on clover and grasses.

Dyar originally described "*Euclidia*" *diagonalis* in 1898[3] from "one female, Mesino Valley, New Mexico."

Lloyd Martin, Associate Curator of Entomology, Los Angeles County Museum, reports that he has been unable to find a record of "Mesino Valley" in New Mexico, and suggests that it may be a misinterpretation of Mesilla Valley.

The series of *E. diagonalis* in the Los Angeles County Museum collection contains 34 examples, the localities represented being: Globe, Ash Fork, Paradise, Patagonia, White Mts., Baboquivari Mts., Madera Canyon, Santa Rita Mts., all in Arizona, and a single specimen from Brewster County, Texas.

The moth is illustrated in Barnes' and McDunnough's "Contributions to the Natural History of Lepidoptera of North America," Vol. 4, No. 2, page 116, plate 15, figure 15, 1918.

JOHN ADAMS COMSTOCK

The Larva of *Stenoporpia grisearia* (Grt.)

(Lepidoptera: Geometridae)

A single example of a geometrid larva was collected on oak, in Madera Canyon, Santa Rita Mountains, Arizona, August 11, 1954, from which the following brief notes were made.

Penultimate instar. Length, 23 mm.

Head: mottled like body, but somewhat darker on the upper half, and whiter below. Ocelli, black.

Body: cylindrical throughout its entire length. Color, superficially appearing dull gray, but actually made up of a reticulated network of fine wavy lines, dashes and dots, ranging in color from soiled white, through brown, to black.

At the juncture of the fifth and sixth segments, in line with the spiracles, there is a warty tubercle, the posterior half of which is black, and the anterior half soiled white.

[2]Forbes, William T. M. Lepidoptera of New York and Neighboring States. Noctuidae. Part III. Memoir 329, Cornell Univ. Agr. Exper. Sta. p. 343. 1954.

[3]Dyar, Harrison G. Jour. N. Y. Ent. Soc. VI, 41, 1898.

On the last caudal segment, mid-dorsally placed, is a warty prominence, mottled black and white.

The remainder of the body is uniformly smooth and mottled.

Legs and prolegs, concolorous with body. A few minute hairs occur on the body, arising from black dots.

Mature larva. Length, 35 mm.

The body color has become a mottled brown, with less contrast between the reticulated lines, dots and dashes.

Spiracles, black, with an aureola of light gray around them.

There is a scant vestiture of very short black hairs, arising from minute black papillae.

The head is mottled somewhat as before, but the lower half is red-brown. A horizontal whitish dash runs across the center, and the upper half is mottled brown.

The larva went underground September 2, 1954, and the imago emerged July, 1955.

The moth was first described by Grote as *Cymatophora (Boarmia) grisearia* in 1883[1] from a single female taken in Arizona by Neumoegen. In Dr. McDunnough's "Studies in North American Cleorini" (Canad. Dept. Agr. Ent. Br. Bull. No. 18, p. 25, 1920) he says of the genus, "Most of the species are decidedly rare and nothing is known of their early stages."

So far as I have been able to determine, that statement still holds good.

JOHN ADAMS COMSTOCK

ACADEMY PROCEEDINGS

Abstract of an address delivered before the Southern California Academy of Sciences on March 16, 1956, by Dr. Jay M. Savage, of the Department of Zoology, Pomona College, entitled

THE MAJOR FEATURES OF LIZARD EVOLUTION

The modern lizards (Order Sauria) comprise a vast array of widely divergent forms adapted to a variety of ecologic situations. The group is primarily terrestrial but many species are arboreal and numerous forms are modified for life under surface debris or as burrowers. Although the majority of lizards are insectivorous, some are partially or exclusively herbivorous, others are mollusk and crab eaters and others prey upon reptiles, birds and mammals.

The order apparently originated in Triassic times but few fossil remains have been recorded earlier than the Cretaceous. The primitive stock of lizards appears to have been derived from the diapsid eosuchians through modifications in the postorbital region of the skull, dental placement and vertebrae. These changes all appear to have been in the direction of adaptations for chasing, seizing and chewing insect prey. Other modifications in lizards also seem correlated with the further development of insectivorous habits.

1Can. Ent. XV. 124. 1883.

plification of the skull through loss of the postorbital (temporal) arch or closure of the supratemporal fossa, as modifications for a fossorial existence. This trend has proceeded along at least 10 independent evolutionary lines within the group to result in a wide variety of burrowing types showing every possible combination of stages of devolution in the listed structures.

The members of the Iguania are essentially terrestrial insectivores. Several genera are herbivorous and some species prey on vertebrates. A number of forms are arboreal and one family, the Chamaeleontidae, of Africa and India, is magnificently adapted for life in the tree-tops.

The Gekkota are an insectivorous group that has taken on nocturnal habits as opposed to the majority of lizards which are diurnal. The geckos proper are mostly nocturnal and mainly arboreal with specially developed eyes (the eyelids are usually immovable and transparent) and a considerable variety of limb, toe and tail modifications to aid them in climbing. One off-shoot from the main line of gecko evolution, the Australasian pygopodids, are burrowers with immovable eyelids, a streamlined skull and the limbs and girdles greatly reduced or absent. Our local night lizards, family Xantusiidae, are also members of this section but are not arboreal or burrowers.

The Anguinomorpha can be divided into two major sections on the basis of morphology and habits. The first section contains a large number of insectivorous species with rather extensive osseous protective plates. These forms are primarily terrestrial, but some are arboreal and several have the limbs, girdles, ears and skull reduced and are snake-like burrowers.

The second line of anguinomorph evolution is formed of a series of relatively large carnivorous terrestrial species. These lizards, including the monitors of the old world and the poisonous beaded lizards of North America, feed on birds, mammals and other large prey. Also placed in this group are a number of extinct fish-eating forms, including the strictly aquatic mososaurs.

Lizard evolution thus appears to have been initiated by adaptation to insectivorous habits. Rather early in its history the order became broken up into four distinctive evolutionary lines that persist today. The primitive forms within each major group were apparently diurnal, terrestrial insectivores, but each line has undergone considerable adaptive radiation. The scincomorph line has developed many fossorial forms with reduced limbs or snake-like appearance. The Iguania have evolved no true burrowers but have developed specializations for arboreal life and some are herbivores. The geckos and their allies are essentially nocturnal, arboreal and burrowing forms. Sime anguinomorphs are limbless fossorial types and one major section has become adapted to feeding on vertebrate prey. In all groups there are species more or less adapted to climbing trees or bushes and others modified for life under surface litter. The basic differences between the major lizard groups and the wide adaptive diversity within each group accounts for the great variety of living species and the marked parallelism between distantly related forms occupying similar ecologic niches. These factors amply explain the evolutionary success of the lizards.

Within the Sauria four major evolutionary lines are indicated, the Scincomorpha, Iguania, Gekkota and Anguinomorpha. These groups are clearly demarcated from one another and at the present time it is not possible to establish one stock as being nearest the ancestral lizards.

The scincomorphs are an insectivorous line, primarily terrestrial, but with some species arboreal in habit. Most of the members of the group are fully limbed and provided with osseous protective plates. However, there has been a marked tendency among numerous scincomorphs toward reduction of limbs and girdles, loss of moveable eyelids and external ears and sim-

ANNUAL MEETING 1956

The annual meeting of the Southern California Academy of Sciences was held on May 4, 1956, on which occasion an address was given by Dr. C. H. Cleminshaw, Assistant Director of the Griffith Observatory and Planetarium, entitled "Exploring the Universe."

Preliminary to this, reports were presented by the officers of the Academy. Included was a report of the Treasurer, Dr. W. Dwight Pierce, which is herein briefly summarized.

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The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

The 1924 issues are: Vol. XXIII, No. 1, January-February; No. 2, March-April; No. 3, May-June; No. 4, July-August; No. 5, September-October; No. 6, November-December.

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Southwest Science Bulletin, May 5, 1920 (all published), chiefly Entomological, 1 color plate 1.00

Check-list of the Recent Bivalve Mollusks (of N. W. Coast of Am. from the Polar Sea to San Diego), W. H. Dall 1.00

A List of North American Lepidoptera in the Los Angeles County Museum. Part I Butterflies (Suborder Rhopalocera), Lloyd M. Martin and Fred S. Truxal. L.A. County Museum Science Ser. #18. Zool. #8, 1955. Price $1.00 (add 15 cents for tax and mailing).

Reprints:

Check-list of the Lepidoptera of Boreal America. Superfamilies Sphingoidea, Saturnioidea and Bombycoidea (printed on one side of page only, to allow of additional notes), Wm. Barnes and Foster H. Benjamin, 1927 $ .50

The Cacti of the Pyramid Peak Region, Dona Ana County, New Mexico, 1931. F. R. Fosberg .25

Check-list of the Macrolepidoptera of Canada and the United State of America by Dr. J. McDunnough, 1938, printed on white bristol board, one side of page (without index) suitable for labels. To Academy members, $1.50. To non-members 3.00

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Issued December 31, 1956

Southern California Academy of Sciences

OFFICE OF THE ACADEMY

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PLEISTOCENE FLORA OF CALIFORNIA WITH EMPHASIS ON TAXONOMIC PROBLEMS IN THE RANCHO LA BREA FLORA[1]

By BONNIE C. TEMPLETON

Curator of Botany, Los Angeles County Museum

There are six important Pleistocene floral deposits in California recorded to date (Map #1). These have been reported in as many publications by Chaney (1, 2), Mason (1, 2, 4, 5), Frost (3), and Potbury (7).

These deposits are located in the Tomales Bay, San Bruno, McKittrick, Carpinteria, Santa Cruz Island, and Rancho La Brea regions. The TOMALES BAY REGION is located in Marin County. There, five plant-bearing localities were found within a distance of 12 miles. In all cases the plant material occurs in lenses of sand and gravel, or as isolated fragments in a sandy conglomerate. Most of the specimens show evidence of having been carried to the site of deposition by water, and no remains of roots or tree trunks *in situ* have been noted.

The SAN BRUNO REGION is located in a tributary to, and in the south branch of San Bruno Creek, a few miles south of San Francisco. The plant material is deposited in a fine alluvial sand which made complete preservation possible.

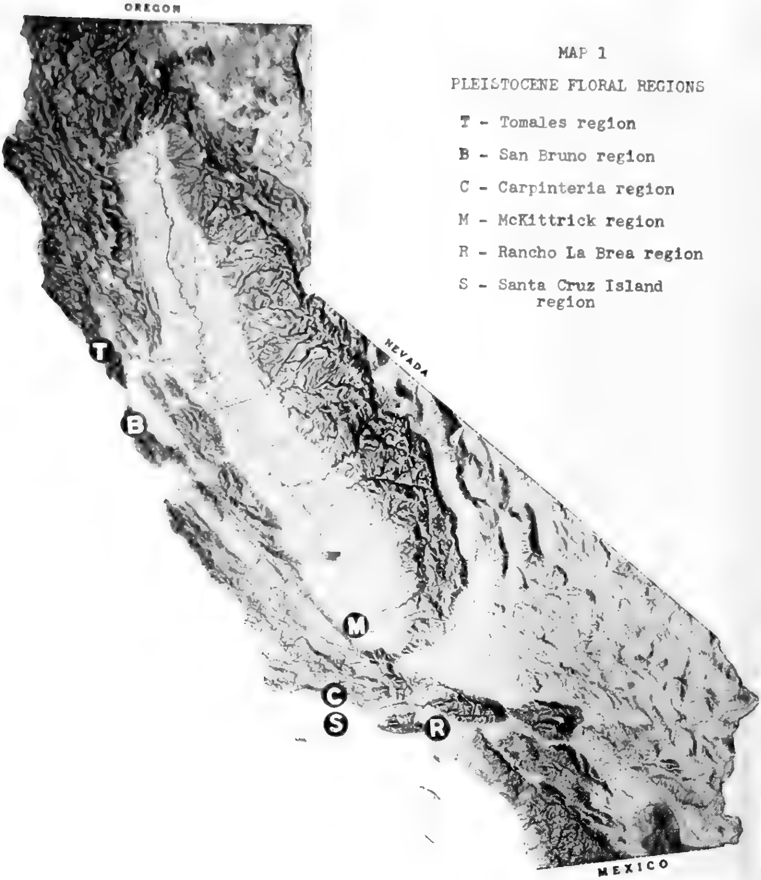
The MCKITTRICK REGION is located in a southwesterly direction from Bakersfield, Kern County. The fossil deposits are in an area of a great number of oil wells and the fossils are imbedded in sand impregnated with asphalt.

The CARPINTERIA REGION is located very near the ocean, one mile southeast of the town of Carpinteria, in Santa Barbara County. The fossils are imbedded in sand, with occasional pebbles in pockets of fine gravel, heavily impregnated with asphalt.

The SANTA CRUZ ISLAND REGION lies 24 miles offshore from Santa Barbara. The fossil flora was found in a canyon of Willow Creek on the west side of the island in alluvial deposits of clay, yellow and gray sands and gravel, and in pockets of gravel and carbonaceous clay.

The RANCHO LA BREA REGION is located in Los Angeles in what is now known as the heart of the Wilshire district. At the

[1] Read at the 8th International Botanical Congress, Paris, July 7, 1954.



time of its discovery, however, it was located about 8 miles from the center of town. The fossils occur in a sandy matrix which is heavily impregnated with asphalt.

Approximately 80 species, including two new forms, have been reported from the Pleistocene deposits of the foregoing regions.

These represent 56 genera of 37 families. One Fungus, 2 Pteridophytes, 13 Gymnosperms, and 66 Angiosperms, and more than 6 undetermined species comprise the total number. Of the more than 80 fossil species reported, 19 occurred in regions no longer inhabited by their modern counterparts.

Although a few species of plants have been reported in several other Pleistocene localities, no important amount of material has been found outside of the six regions enumerated above. The plant material from the three regions in which the matrix is impregnated with asphalt is better preserved than that of the other localities.

The Plesiotype material from the Tomales, San Bruno, McKittrick, and Santa Cruz Island regions is deposited at the University of California at Berkeley; that of the Carpinteria region is deposited at the Santa Barbara Museum of Natural History; that of Rancho La Brea, in part, at the University of California and, in part, at the Los Angeles County Museum.

The writer is now engaged in a review of the records and material of the Pleistocene floras in California in connection with an intensive study of plant material — especially seeds — from the Rancho La Brea deposits. It is anticipated that many species will be added to the list of California's fossil plants, and it is hoped that our knowledge of the climate and flora of California in the Pleistocene may be considerably extended.

The first work of excavation at Rancho La Brea was carried on at intervals from 1907 to 1913 by the University of California, Southern California Academy of Sciences, Occidental College, and the Los Angeles High School. In 1913, Mr. G. Allan Hancock, owner of the Rancho, granted to Los Angeles County exclusive privilege to excavate these deposits, and later, he generously gave the tract of land on which the famous fossil beds occur (approximately 23 acres) to Los Angeles County with a request that the scientific features be adequately preserved and exhibited.

More than 100 excavations, or pits, were made at Rancho La Brea by the Los Angeles County Museum in search of fossil deposits. It has been generally reported that many of these deposits contained only fossil bones, others contained bones and plant material alike, while many others yielded nothing. However, from a study of the field notes made at the time of the various excavations, it can be determined that some of the pits, supposedly containing bones only, also contained fossil plants, while in some of the pits only plant material was noted.

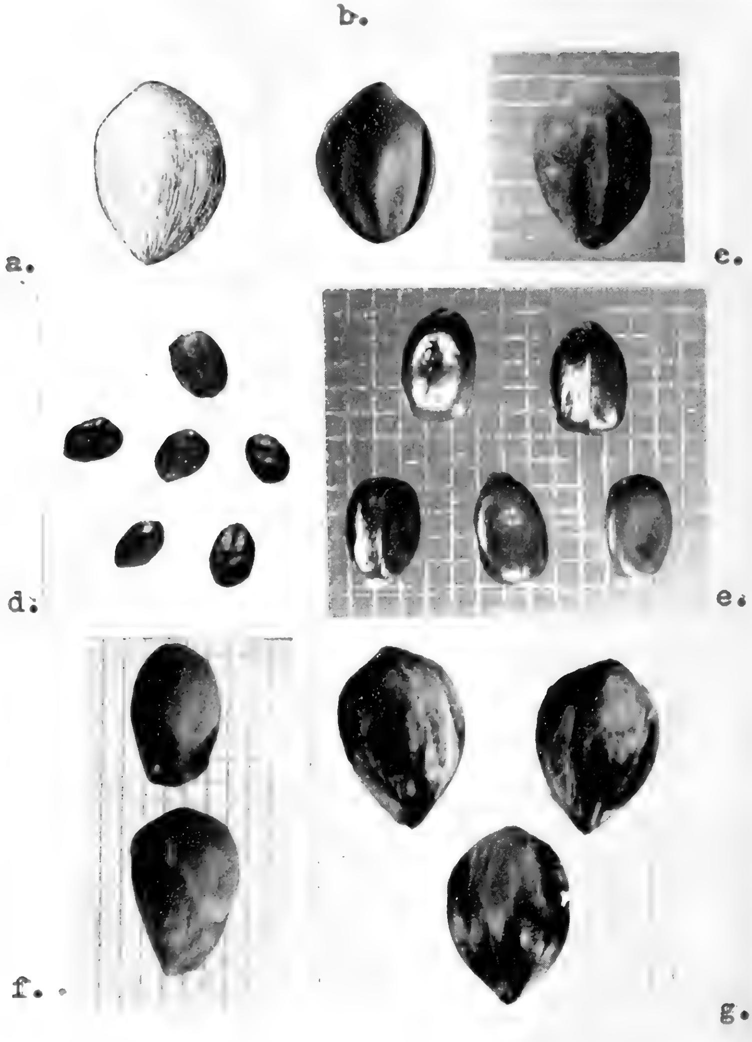


PLATE 32

Fig. a. — *Juniperus californica,* McKittrick deposits; ca. 3x, (5) plate 23, fig. 1

Fig. b. — *Juniperus californica,* Carpinteria deposits; ca. 3x, (2) plate 6, fig. 10

Fig. c. — *Juniperus californica,* Rancho La Brea deposits.

Fig. d. — *Juniperus californica* var. *breaensis,* Rancho La Brea; ca 2x, (3) plate 15, fig. 4

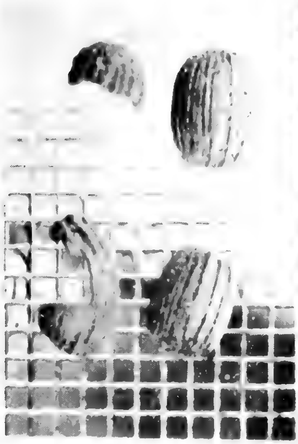
Fig. e. — *Ceanothus Jepsonii* (modern), L. A. Co. Mus. coll.

Fig. f. — *Juniperus utahensis* (modern), L. A. Co. Mus. coll.

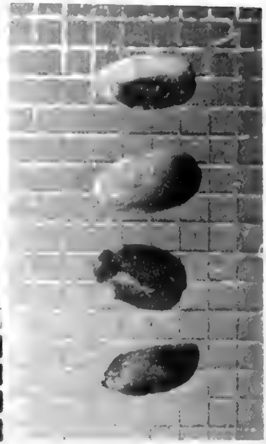
Fig. g. — *Juniperus californica* (modern), L. A. Co. Mus. coll.

These field notes indicate the presence of plant material in at least seven pits, but apparently little of it was considered of sufficient importance to keep. The great abundance and striking massiveness of some of the bones so absorbed the attention of the excavators that only meager regard was given to the plant material. Our greatest source of fossil plant material now on hand has been obtained in the washing and cleaning of the skulls and bones from the various excavations. Many seeds, leaves, and twigs are being extracted from the matrix inside of skulls, and even from the cavities of beetle bodies. Pit records on the skulls provide the data for these plant fossils and indicate occurrence of plant material in six pits in addition to those reported in the field notes.

The only previous report on the flora of Rancho La Brea was written by Frederick Frost (1927), based mainly on material collected by the University of California. He lists six species which are probably but a small portion of the number yet to be identified in the material now being extracted from the matrix at the Los Angeles County Museum. At the time of Frost's report, very little was known of the Pleistocene flora of California and he labored under considerable handicap in making his determinations, especially of seeds and cones. From certain illustrations and some of the written description, it would appear that there are several discrepancies in identification. For example, *Juniperus californica* var. *breaensis* (Pl 32, fig. d) is illustrated by a group of seeds that show very little similarity to seeds of *J. californica* (illustrated) from other deposits (Pl. 32, figs. a, b, c) or to those of living seeds of this species (Pl. 32, fig. g), or of *J. utahensis* (Pl. 32, fig. f) (which variety breaensis is supposed to represent as an interrelated species). On the contrary, they more closely resemble seeds of *Ceanothus Jepsonii* (Pl. 32, fig. e). I have not been able to locate the material upon which Frost based his work to determine the accuracy of the illustration. In another instance, *Celtis mississippiensis* var. *reticulata* (ref. to *C. Douglasii* by several authors of modern California flora) was reported without illustration but the description given appears to describe more accurately seeds we are finding (Pl. 33, fig. a) that do not compare with those of modern or fossil *Celtis*.



a.



b.

c.

d.

PLATE 33

Fig. a. – Seeds from Rancho La Brea deposits (unidentified).
Fig. b. – Seeds from Rancho La Brea deposits (unidentified).
Fig. c. – *Sambucus glauca*? Rancho La Brea deposits.
Fig. d. – Seeds of a *Compositæ* (unidentified), Rancho La Brea deposits.

Note: All photographs with the grid background taken by the author; each square in the grid = 1 sq. mm.

Three pine cones were found in the deposits at Rancho La Brea. Two of these were found in Pit 9, one imbedded in the socket of an elephant scapula. One of these cones was reported by Frost as *Pinus tuberculata* (or *P. attenuata* by most authors), but Mason recognizes this cone as *Pinus muricata*. From my somewhat brief study of the three cones, it appears that there may be three different species present.

The greatest problem, and a serious handicap in the identification of this fossil material, particularly of the seeds and fruits, is one of taxonomy and morphology. So little is done in the description of modern species to adequately describe the fruits and seeds. For instance, in the descriptions of *Juniperus californica*, the berries are said to contain 1 or 2 seeds, or 1-3 seeds, or no mention of the seeds is made at all. Their form, size, or other characters which would distinguish the seeds of one species from those of another are rarely if ever noted. Such information would be very important since *Juniperus californica* is reported from at least three Pleistocene deposits in California.

Some work has been done on seed morphology in a few families in the Floras. Since considerable use is being made of seed morphology in the field of seed analysis, comprehensive studies of this phase in more plant families should be undertaken. The seed analyst must recognize and designate weed seeds occurring incidentally with agricultural seeds. In this connection some studies have been made of the anatomy and morphology of the weed seeds encountered. In the study of fossil seeds, the external form and structure is very important, not only in such material as we are getting from the Rancho La Brea deposits (where the actual organic material is preserved) but in the many instances of fossil impressions of seeds.

One of the chief barriers to seed morphology is the lack of a suitable terminology to describe the many variations found in seeds. In 1951, Murley (6) illustrated the terms used in her keys and in the descriptions of seed coats of Cruciferae. Although this wonderful work covers a certain group of characters encountered in the seeds of this one family, much more is needed before one can adequately describe all the different characters that may be found in seeds and fruits of the thousands of species of Spermatophytes.

Of the numerous kinds of seeds that have been recovered from the Rancho La Brea matrix, several are illustrated here to point out the problems involved in their identification. Those shown in Pl. 33, fig. c, appear to represent those of *Sambucus glauca* although they bear resemblance, also to seeds of *Oxalis* and of *Phacelia*. The seeds in Pl. 33, fig. b, may be those of a species of *Ceanothus* of a *Euphorbia*, but there are also several

other kinds of plants having similar seeds. Plate 33, fig. d, shows seeds that belong to a species of the *Compositae* family. But, to be certain of the identification of these seeds, further comparative studies will be necessary. Very meager mention is made in the descriptive Floras of the shape or form, texture, surface markings, or other characters which would facilitate their determination. Lacking these data for most of the seeds and fruits of the modern plants, it will be necessary to study very carefully this phase of the living plants of California, and possibly elsewhere, before an accurate identification can be made of the fossil seeds of the Rancho La Brea deposits.

The discrepancies noted in this paper are not mentioned in a spirit of criticism, but to point out the lack, or very meager description of seeds in plant taxonomy. If the International Rules of Botanical Nomenclature could be so revised that a complete description of the fruits and seeds of a species would be a requirement of naming a new species of living Spermatophyte, the problems of identification of both living and fossil plants would be greatly lessened. In turn, such information would eventually lead to a more complete understanding of the phylogeny of the flowering plants.

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TIGER BEETLES of the GENUS *CICINDELA* in SOUTHWESTERN NEVADA and DEATH VALLEY, CALIFORNIA, and DESCRIPTION of TWO NEW SUBSPECIES

(COLEOPTERA - CICINDELIDAE)

by Norman L. Rumpp
China Lake, California

The tiger beetles of Death Valley, Inyo and San Bernardino counties, California, and regions associated with the Amargosa River in Nye county, Nevada, are still relatively unknown. The author has devoted many of his spare moments to the observation and study of these populations wherever found in this vast remote region of the Great Basin. Though much work remains to be done, it appears appropriate at this time to publish some of the results of those efforts. Sincere appreciation is hereby expressed to both Dr. Mont A. Cazier whose advice and encouragement have been most helpful, and Mr. F. W. Binnewies, superintendent of the Death Valley National Monument, whose permission made possible the accumulation of all Death Valley specimens.

The first part of this paper deals with Death Valley populations. Five subspecies of tiger beetles of the genus *Cicindela* have so far been identified with Death Valley, and collected specimens at hand have verified their existence in this region. These are:

C. willistoni pseudosenilis W. Horn 1900, Ent. Nach. XXVI, p. 218

C. amargosæ amargosæ Dahl 1939, Bull. Brook. Ent. Soc., vol. XXXIV, p. 221

C. californica erronea Vaurie 1951, Amer. Mus. Nov., no. 1479, p. 12

syn. *C. californica viridicyanea* Vaurie 1950, Amer. Mus. Nov., no. 1458, p. 1

C. nevadica nevadica LeConte 1875, Trans. Amer. Ent. Soc., V, p. 159

C. hæmorrhagica hæmorrhagica LeConte 1851, Ann. Lyc. Nat. Hist. N. Y., V, p. 171

The following subspecies has been reported from Nevada and Death Valley (Cazier 39: 27), but its actual existence in the Valley has not been verified:

C. denverensis propinqua Knaus 1922, Journ. N. Y. Ent. Soc., XXX, p. 194

The information made available here on the *Cicindela* fauna of Death Valley is based on the populations found in two areas located approximately 80 miles apart.

I. The one area is located on the eastern edge of the Valley's alkali sink, and is divided into two sites:

a. One site is seven miles north of Furnace Creek, extending both north and south of this point for some distance, at an elevation of 260 feet below sea level. Here, natural springs known as Salt Springs drain almost the year around in long rivulets which flow generally westward into the open alkali flats. Alkali-resistant grasses grow thickly at the edge of these flats, except in drainage areas where the ground is relatively free of grass and alkali.

b. The other site is along the southern end of Salt Creek, 17 miles north of Furnace Creek, at an elevation of 200 feet below sea level. Here, this permanent section of the creek fans out and disappears underground leaving extensive sand bars exposed.

II. The other area is located across the normally dry Amargosa River bed, one quarter mile west of Saratoga Springs in San Bernardino county, California, nearly 75 miles south of Furnace Creek. This area extends for several miles to the north of Saratoga Springs, on a gradual down-hill slope from an elevation of 200 feet. At this location the river bed is made up of numerous channels through alkali and sand bars, covered here and there with short grasses. The footing usually reveals dampness just below the surface. At some places pools of water are found which sometimes contain fishes of the genus *Cyprinodon.*

Several other places were visited on occasion in quest of *Cicindela,* but no beetles were found. These places include Stovepipe Wells, upper Salt Creek, areas around the few masonry covered wells in the middle Valley, Tule Spring, Badwater, and pools to the south which are permanent bodies of water so surrounded by salt incrustations that tiger beetles cannot live in the vicinity. Other likely habitats are at the ruins of the old Eagle Borax Works, at Furnace Creek Ranch, and along the waterway east of Furnace Creek Inn.

A closer examination of the site seven miles north of Furnace Creek reveals that all five subspecies occupy it. Though as many as four of these may be found at any one time, it appears that each

dominates the site in turn, indicating that some balance has been reached in their competition for this limited living space. They appear as follows:

I. A population of *C. willistoni pseudosenilis* is the first to make its appearance. Individuals of this population prefer the damp flats at the western edge of the grassy area, and occasionally may be found far out on the alkali flats. Specimens are always a constant dark green or blue-green, with white maculation; the lunules are always present, usually complete, and in many individuals more narrow than is found in Owens Lake samples. This population and the next compete for the site on fairly even terms at nearly the same time; they have also been found together in November. Observation indicates that ssp. *pseudosenilis* takes cover on very windy days, when wind velocities approach 30 miles per hour and up.

II. The next population seen is one of *C. amargosæ amargosæ*. This is treated here as a distinct species, and not as heretofore when it was known as a subspecies of *C. willistoni*, for such sufficient reasons that two distinct subspecies of the same species cannot exist sympatrically, that no interbreeding with ssp. *pseudosenilis* has ever been observed, and that no hybrids have ever been found; this is in general agreement with the original observation by Dahl (39:222). It will be shown later that *C. amargosæ* is polytypic. Individuals are very numerous in April; by mid-May they are seen in reduced numbers, but still mating; by June they disappear. They invade the grassy area where the ground is moist and darkest; they are most numerous where the waters of the springs drain off, and are frequently seen standing in the very shallow spots, often mating in this surrounding. Visual evidence indicates that they are more active on overcast or partly cloudy days, possibly because they live, as a rule, among the alkali-resistant grasses where some shade may be obtained. They will appear when the wind velocity is very high. Their color is a medium dark shade of green or blue-green in April, becoming darker in May but never black as in some Nevada specimens. Their elytra are very hard and brittle, becoming more so as the season wears on. This site, or one slightly to the south, is the type location of this subspecies. It has not been found at any other location.

III. The third population to be seen is of subspecies *C. californica erronea.* This is the first mention of this new location in California for this striking blue and green subspecies, which heretofore was known only from the vicinity of Willcox, Cochise county, Arizona (Vaurie 50:1). Individuals are first seen in mid-April; by the beginning of May they take over the site in large numbers. In the early period of their emergence they are competing for space with ssp. *amargosæ*, and are then found mostly along the shallow streamlets in open spots away from the grassy area. When they predominate they close in to the edge of the grasses where there is flowing water. They frequently walk in the shallow water where they too do not hesitate to mate.

IV. *C. nevadica nevadica* makes up the fourth population to appear. This sub-species so common at Ash Meadows in Nevada, has never before been reported from Death Valley. Individuals emerge in the latter part of April, from a few to increasing numbers by May. They disappear in June when the water at this site recedes to a few isolated puddles. These unusually wary *nevadica* blend well with their background, invading by preference the edges of water runs where the sand is exposed and reasonably free of alkali. They are rapid runners and short flyers. From mid-April to mid-May, populations of the above four subspecies may be found in greater or lesser numbers at this site.

V. The final population to emerge is composed of *C. hæmorrhagica hæmorrhagica.* Adults appear at the end of May and probably outlast all the other populations. At that time this same subspecies is commonly found throughout Southern California and some parts of Nevada. Individuals from Death Valley appear to be fully maculated.

At the Salt Creek site only two subspecies have been observed. *C. willistoni pseudosenilis* was collected in May, after it had disappeared from the site seven miles north of Furnace Creek. At the same time *C. nevadica nevadica* was as plentiful here as in the populations above Furnace Creek.

The author has not visited the Saratoga Springs area of Death Valley as frequently as the Furnace Creek area because of the greater distance involved and the general poor condition of the roads south of Badwater. The populations found here include *C. willistoni pseudosenilis*, *C. californica erronea*, and *C. nevadica nevadica*. *C. amargosæ* does not appear at this location in any

form, and it is surprising that even hybrids have not been encountered. The ssp. *pseudosenilis* population differs from the northern population in that the maculation is still more reduced, with a few immaculate or nearly immaculate individuals appearing in any sample. A much more extensive population of *C. californica erronea* may be observed here, with the individuals usually lurking among the grasses, but not hesitating to appear in the open; when water is present they will walk into the shallower spots; they are not very wary, and can be approached very closely. *C. nevadica nevadica* is also very common at this location, and is always found on the alkali-free mud or sand bars, usually where it is wet and water is exposed.

A few miles upstream of Saratoga Springs, the Amargosa River makes a wide turn where it reverses its course from the northwest as it comes out of Inyo county. Here, along the river bed at Shoshone, California, and extending a few miles south of the town, there is a new subspecies of *C. willistoni* that exhibits a nearly constant reduction in maculation and size.

Cicindela willistoni prædicta, new subspecies

Medium size, narrow and convex, head and prothorax green; elytra blackish-blue, immaculate except for two small vaguely marked apical spots. Head and prothorax as in subspecies *echo* except that the basic color is green, with only faint highlights of bronze; impressions of the prothorax deep and colored blue; second joint of male palpi pigmented; antennae slender, the first four joints green. Elytra coarsely and fairly evenly punctured, with slightly heavier punctures in the impressions; they broaden evenly from the shoulder to the apical two-thirds; there are no humeral or median lunules, and the apical are reduced to vestigial crescents near the suture. Underside brilliant blue, clothed with white decumbent hair; femora blue with green joints, tibae green. Male—length 11.1 mm, width 4.4 mm. Female—like the male except for larger size and broader proportion; length 11.4 mm, width 5.0 mm.

Holotype male, allotype female in the author's collection. Collected at the type location 3.5 miles south of Shoshone, Inyo county, California, on April 17 and April 8, 1956 respectively. 55 paratypes collected as follows: Shoshone, April 3, 1955 (1), April 18, 1955 (5); 3.5 miles south of Shoshone, April 18, 1955 (9), April 7, 1956 (11), April 18, 1956 (11); Carson Slough, Ash Meadows, Nye county, Nevada, March 18, 1956 (1), April 8, 1956 (3), May 5, 1956 (14).

A distribution of paratypes was made as follows: 2 to Dr. Mont A. Cazier of the American Museum of Natural History, and 2 to Dr. E. S. Ross of the California Academy of Sciences.

Type location: 3.5 miles south of Shoshone, Inyo county, California, in the Amargosa River bed. At this location the river bed is broad and the water, which is usually present, breaks up into numerous parallel rivulets which cut narrow meandering paths through the alkali beds. A type of brownish alkali-resistant grass grows in clumps and patches in this area. The type location is along the westernmost waterway. This gregarious population is restricted to a narrow band only a few feet wide and not over 150 feet long. Upon leaving this small strip, the appearance of *C. denverensis propinqua* may be noticed. The leached out crust of salt and alkali is very white and nearly one half inch thick; underneath, the ground is brown and moist. The adults hide under this crust. On very windy days they may be seen walking on the alkali where they are readily noticed; though they are good flyers, usually flying short distances at one time, they are rarely seen taking to the air during windy weather, a characteristic typical of *pseudosenilis* and *echo*-like populations. In May this population is easily confused with the dull colored ssp. *propinqua* population which intermixes with it.

At Ash Meadows, along Carson Slough, the ssp. *prædicta* population is restricted to an area a few feet wide by not over 200 feet long; adjacent to this area may be found both ssp. *propinqua* and *amargosæ* hybrids.

The *prædicta* populations exhibit the same extreme reduction in maculation observed in other *Cicindela* groups of the upper Amargosa River region. The absence of maculation is not constant, varying from completely immaculate individuals to a few narrowly maculated individuals quite like those of Death Valley populations. A comparison of length in various populations of ssp. *echo, pseudosenilis,* and *prædicta* indicates that there is a nearly continuous reduction in size with distance, as shown in Table A.

sub-species	population	sample size			longest	shortest	average length (mm)			s
		n	♂	♀	(mm)	(mm)	$\bar{X}$	$\bar{X}$ ♂	$\bar{X}$ ♀	
echo	Great Salt Lake	12	9	3	12.6 ♀	10.8 ♂	11.86	11.78	12.10	.28
	Koehn Lake	26	14	12	13.6 ♀	11.3 ♂	12.20	12.00	12.50	.39
pseudosenilis	Owens Lake	30	15	15	13.4 ♀	10.3 ♀	12.05	11.85	12.26	.66
	Furnace Creek	30	15	15	12.9 ♀	10.8 ♂	11.80	11.60	12.00	.42
	Saratoga Springs	19	10	9	12.1 ♂	10.6 ♂	11.40	11.40	11.32	.42
prædicta	Shoshone	15	10	5	12.2 ♀	10.5 ♂	11.27	11.10	11.66	.40
	Ash Meadows	18	10	8	12.0 ♀	11.0 ♀	11.59	11.47	11.70	.24
total		130	83	67						

TABLE A[1]

Comparison of Length in Various Populations
of *C. willistoni echo, pseudosenilis,* and *prædicta.*

Subspecies *prædicta* cannot be readily differentiated because of its smaller size, as size may vary because of the effect on the larvae of yearly rainfall, temperature gradients, and food supply. Color differences in the *willistoni* complex may be significant since they appear to be explainable by the degree of hybridization and

1. The algebraic formula for the calculation of variance used in this paper is:

$$s^2 = \left[\sum (x^2) - \frac{\left(\sum x\right)^2}{n} \right] \bigg/ n - 1$$

where the square root of the variance is termed the "estimated standard deviation", and is denoted by the letter s. The $\bar{X}$ (x bar) denotes the average, or mean, of the individual measurements X considered in n samples.

isolation of the various populations. However, a more reliable method is comparison of the degree of maculation with the nearest populations, as shown in Table B.

Type of elytral maculation	Average % coverage	Ash Meadows	Shoshone	Saratoga Springs	Furnace Creek	Owens Lake	Koehn Lake	Great Salt Lake
		number in population						
confluent	31						6	
broad	21				3	5	17	3
medium	14			7	51	52	2	9
narrow	9	3	1	6	8	2	1	3
reduced	6		1	4	5			
spotted	3	5	8		1			
immaculate	.2	10	29	2				
total population sample		18	39	19	68	59	26	15
average % coverage, $\bar{X}$		2.4	1.2	9.3	12.9	14.4	22.3	14.4

TABLE B

Comparison of Percentage of Maculation Coverage in various Populations of the *C. willistoni* complex.

By this it can be shown that the Shoshone population of ssp. *prædicta* is significantly different from the population of Saratoga Springs. The Saratoga Springs population is more nearly similar to the northern populations of Death Valley and is therefore to be included with ssp. *pseudosenilis*. The dark blue-black color influence of ssp. *prædicta* is observed in all Death Valley and Owens Valley populations, decreasing with distance, while the

degree of maculation increases steadily. Subspecies *prædicta* may have once populated the shores of ancient Lake Tecopa, the Amargosa River into Ash Meadows, and even the connecting river into ancient Lake Pahrump which filled the valleys to the east between the Spring and Nopah Mountains. That still better defined immaculate representatives of the parent stock still exist in that area is a good possibility. Hybridization with the ancestral *echo* seems to have occurred in two directions, namely southward via the Amargosa River through Death Valley to the Owens Lake basin, and northward along a path now too indistinct to trace. This would explain in part why the Ash Meadows population exhibits more joint overlap with ssp. *pseudosenilis* than does the Shoshone population.

The Koehn Lake (Saltdale) population from Kern county, California, is placed with ssp. *echo* because it is hardly influenced by blue coloring, and bears much wider maculation. This indicates the possibility that ssp. *prædicta* intruded on the ssp. *echo* populations during one of the last pluvial periods, and that Koehn Lake, though not linked with the Death Valley System during that period, was connected to it during an earlier period.

C. nevadica nevadica is present at all locations in the vicinity of Shoshone. At Tecopa and Tecopa Hot Springs, located in Inyo county, eleven miles southeast of Shoshone, *C. denverensis propinqua, C. nevadica nevadica,* and *C. hæmorrhagica hæmorrhagica* were noticed during the month of May.

In Nye county, Nevada, between Beatty and Springdale, at an elevation of about 3400 feet, the highway passes through alkali beds, intermittent streams, and damp meadows which constitute the normal channel of the upper Amargosa River. This is about 110 miles upstream of Saratoga Springs, or 190 miles from the location near Furnace Creek by following the river channel; by road it is only 44 miles from Furnace Creek, but separated by the Funeral Range, which may be crossed at Daylight Pass. This mountain range and other lesser ranges to the east form a barrier that effectively separates the tiger beetles of both locations. Four populations of the genus *Cicindela* live sympatrically in this upper region of the Amargosa River, and are:

C. tranquebarica kirbyi LeConte 1866, Proc. Acad. Nat. Sci. Phila., p. 362.

C. amargosæ nyensis, a new subspecies described below.

C. pusilla imperfecta LeConte 1851, Ann. Lyc. Nat. Hist. N.Y., V, p. 171.

C. nevadica nevadica LeConte 1875, Trans. Amer. Ent. Soc., V, p. 159.

The first populations are observed in late March and early April, and consist of *C. tranquebarica kirbyi* with ever increasing numbers, until mid-May, and *C. amargosæ nyensis* new subspecies, which is most abundant in April.

Cicindela amargosæ nyensis, new subspecies

Medium small in size, sericeous, black above with very faint green reflections in the muricate wrinkles of the prothorax and scutellum, and still fainter blue traces in and around the punctures of the disk of the elytra. Sparse hairiness above, consisting of a few hairs in line near the lateral edges of the prothorax, and a few scattered hairs on the frons; beneath rather densely hairy. Head and prothorax as in ssp. *amargosæ* but smaller, and labrum relatively shorter; color uniformly black with very faint blue-green reflections in the rugosity of the prothorax; the deeper transverse impressions of the head and prothorax have stronger blue and green tinges. Elytra glabrous, sides widest at apical third as in ssp. *amargosæ,* then evenly rounded to apex; sericeous, black, with impressions faintly bluish, and purplish coloration near the base of the elytra; the small roughly triangular apical spots are very small. Underside is of a uniformly polished dark blue, the hairs are placed as in ssp. *amargosæ.* Legs black with faint green reflections that become bluish near the joints. Male—Length 10.4 mm. width 4.2 mm. Female—same as the male except for larger size and wider proportion; length 10.9 mm., width 4.9 mm.

Holotype male, allotype female in the author's collection. Collected April 16, 1955 with 48 paratopotypes, and an additional 106 paratopotypes collected on April 23, 1955. A distribution of paratypes was made as follows: 22 to Dr. M. A. Cazier of the American Museum of Natural History, 4 to Dr. E. S. Ross of the California Academy of Sciences, 2 to Dr. F. S. Truxal of the Los Angeles County Museum, 2 to Dr. W. J. Brown of the Canadian Department of Agriculture, and 2 to the Reverend B. Rotger of Pagosa Springs, Colorado.

Type location: 1.6 miles south of Springdale, Nye county, Nevada; in the Amargosa River bed, along mud flats at the edge of small rivulets, in patches of short grasses. The individuals live among these grasses and are readily flushed. They are reasonably wary, but their flight is weak and short. They are not as robust as ssp. *amargosæ,* and their elytra are much softer. The ssp. *nyensis* population differs from ssp. *amargosæ* by the black color which bears faintly colored reflections that are visible only under magnification, by the apical maculation that is more reduced, and by the smaller size. A comparative analysis of length, which is

one of the obvious differences, was made between a series of 50 ssp. *nyensis* and a series of 69 typical ssp. *amargosæ* from near Furnace Creek, Death Valley, California. The results of these measurements are shown in Table C.

ssp	population	sample size			longest (mm)	shortest (mm)	average length(mm)			s
		n	♂	♀			$\bar{X}$	$\bar{X}$ ♂	$\bar{X}$ ♀	
amargosæ	Furnace Creek	69	23	46	13.4 ♀	10.7 ♀	12.0	11.4	12.2	.65
nyensis	Springdale	50	23	27	11.9 ♀	9.4 ♂	10.7	10.4	10.9	.49
	total	119	46	73						

TABLE C

Comparison of Length in Populations of
C. amargosæ amargosæ and *nyensis*.

The report by R. G. Dahl (40:79-80) indicates that *amargosæ* specimens collected in northwestern Nevada and nearby areas of California show variable color patterns between black, green, and bronze. In a letter to the author (1954) M. A. Cazier mentions that at Gerlach and other places in northern Nevada the population samples run about fifty-fifty green and black. This would indicate that there are extensive hybrid populations. At Ash Meadows, Nevada, approximately 50 miles downstream of the *nyensis* type location, at the edge of a connecting stream known as Carson Slough, the author has collected individuals from a hybrid population that show characteristics of both subspecies, and at their extremes are indistinguishable from typical ssp. *amargosæ* and typical ssp. *nyensis*. The hybrid area lies between the type locations of both subspecies, along the Amargosa River which nearly connects all three populations. The population of ssp. *amargosæ* near Furnace Creek is constant in its larger size and maculation, and medium green color. This latter location is not a part of the Amargosa River drainage system as reported

(Dahl 39:222), but of the Salt Creek system which flows south from near Lida, Nevada; both systems meet at Badwater some 30 miles south of the type location of ssp. *amargosæ*. Since the two systems rarely flow simultaneously, it is quite probable that the two subspecies are now totally allopatric. Furthermore, from the lack of ssp. *amargosæ* at Saratoga Springs, it appears that the hybrid population of Ash Meadows has become completely isolated from the parent stocks in recent times.

In May and June, *C. pusilla imperfecta* is present in great numbers near Springdale. The color of this subspecies is bright blue and blue-green. Individuals of *C. nevadica nevadica* may also be found near Springdale at the same time.

Ash Meadows is located northeast of Death Valley Junction, California, and lies mostly in Nye county, Nevada, between the Amargosa Desert and the Resting Springs Mountains, at an average elevation of about 2200 feet. Five subspecies of *Cicindela* have been found there, scattered in greater or lesser populations wherever water is most abundant and permanent. These are:

C. denverensis propinqua Knaus 1922, Journ. N.Y. Ent. Soc., XXX, p. 194 syn. *C. arida* Davis 1928, Pan-Pac. Ent., vol. V, no. 2, p. 65.

C. willistoni prædicta, new subspecies.

C. amargosæ hybrids *(amargosæ* X *nyensis).*

C. nevadica nevadica LeConte 1875, Trans. Amer. Ent. Soc., V, p. 159.

C. hæmorrhagica hæmorrhagica LeConte 1851, Ann. Lyc. Nat. Hist. N.Y., V, p. 171.

Not found by the author are *C. punctulata punctulata* Oliv., *C.* var. *chihuahuæ* Bates, and *C. tenuisignata* Lec., all reported by W. Knaus (22:194-195). The existence of *tenuisignata* in Ash Meadows is very probable in the opinion of this author, but he ventures that there was some confusion in reporting the existence of ssp. *punctulata* and ssp. *chihuahuæ* in this region. The populations were observed as follows:

I. The first populations noted at Ash Meadows are those of *C. denverensis propinqua, C. willistoni prædicta,* and *C. amargosæ* hybrids. Subspecies *propinqua* has been encountered as early as March along Carson Slough, from Nevada into California, also at Bole Spring and near Ash Meadows Lodge, both in Nevada. The type location for ssp. *propinqua* is in the northern part of the Meadows in the drainage area of Fairbanks Springs, at the

headwaters of Carson Slough. This unusually bright green *Cicindela* may be doubtfully classed as a subspecies of *C. denverensis* as originally reported (Knaus 22:194) and later verified by Nicolay and Weiss (32:352), and Davis (29:100), but it is this author's opinion that it is a close relative of the *purpurea* group, and that alliance to *tranquebarica* (Horn 30:81, Cazier 39:37) will stand review. Of 118 individuals collected in March and early April 1955, only 3 could be called muddy green as reported by A. C. Davis (28:65) in his description of the synonymous *C. arida;* but the May specimens are nearly all muddy green. Many of the early individuals possess brilliant coppery reflections that could class them among our most beautiful tiger beetles; unfortunately, this brilliance fades within a few days after death to the basic bright green, with only a few specimens retaining a small measure of their former brilliance. Subspecies *propinqua* prefers the whitest alkali flats at the farthest edge of streams and damp places. These areas are always sparsely covered with alkali-resistant grass stubbles. The individuals hide under these grasses, and when flushed make one long flight into the open where they may be easily caught. They generally stay fairly apart from each other over an extended area; a considerable amount of walking is necessary to net a few. Specimens were collected under the same conditions at Shoshone, Inyo county, California, in the bed of the Amargosa River, along with ssp. *prædicta.*

II. *C. nevadica nevadica* reaches its greatest population count in Ash Meadows. Individuals have been located at Springdale, Nevada; Death Valley, Inyo and San Bernardino counties, and as far west as Saltdale (Koehn Lake), Kern county (Cazier 37:117), and Saline Valley, Inyo county, California; but they have never been seen in the numbers encountered at Ash Meadows in June and July. While staying at Ash Meadows Lodge one evening in June of 1954, the author found ssp. *nevadica* swarming at lights and had to shut the door to his room to keep them out. They have been collected at several places in Ash Meadows, always near water. When out in numbers they are easy to collect as their flight is short, usually from one side of a stream to the other. Their color is brown over a green background. They prefer open ground where they blend well with their surroundings, while avoiding alkali covered areas.

III. *C. hæmorrhagica hæmorrhagica* is not uncommon at Ash Meadows from June onward. It prefers muddy areas where the ground is darkest, always at the edge of water. Individuals vary from fully maculated to coal black, all within the same population.

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NOTES ON THE GENUS ISOMIRA (ALLECULIDAE), AND A NEW SPECIES FROM ARIZONA

(Notes on North American Coleoptera, No. 2)

By CHARLES S. PAPP

A new species of alleculid beetle was recently taken in southern Arizona by Dr. John Adams Comstock, which is herein described, and its relationship to certain other members of the genus briefly discussed.

A list of all members of the genus occurring in the United States is appended. The numbers preceding each species are those of the Leng's Catalogue of the Coleoptera of America, North of Mexico.

11305. **Isomira discolor** Csy. (Annals N.Y. Acad. Sci., VI. Nov. 1891, No. 2, p. 145-146). — A moderately convex, piceous black, rather strongly shining, elongate-elliptical species, with throughout concolorous antennae and legs, pronotum and prosternum pale ferruginous, the pubescence fine, very short and sparse. The head distinctly shining, the comparatively wide interspaces of the punctures being polished. Small, 3.5 — 4.0 mm.

Described from California. Fairly rare: 3 specimens collected by R. Hopping in Kaweah, Calif. are in the collection of Mr. G. P. Mackenzie (San Marino, Calif.) and one specimen collected by the writer on July 2nd, 1956 in hte Tokopeh Valley, Sequoia National Park, Calif. on about 7,000 ft. elevation.

11307. **Isomira sericea** (Say). (Journ. Ac. N.S. Phila. III, 1823, p. 270). — This is an eastern species, previously reported from Massachusetts to North Carolina, Florida and Indiana. Specimens from Baltimore, Maryland (collected by F. E. Blaisdell, June 26, 1909) and Pelham, Mass. (by Marion E. Smith, June 6, 1942) are in the Mackenzie collection and in that of the author, as are also 8 specimens from Rochester, N.Y. (by F. C. Fletcher, July 26, 1947).

I. sericea are elongate-elliptical, evenly convex, feebly shining beetles, with fine pubescence. The head is dull, densely punctate and evenly convex. Antennae long and slender, nearly two-thirds as long as the body, and the fourth joints are equal in both sexes. The prothorax is one-half wider than long, the sides rounded anteriorly, nearly straight and parallel in basal half. The elytra are nearly four times longer than the prothorax, the narrowly rounded humeri wider than the thoracic base, rather acute at apex, finely punctured with three or four impressed striae near the suture, and more strongly marked at apex. Where the striae are deeply impressed they become very minutely punctate. Elsewhere there is no trace of serial punctuation.

The under surface is shining; the abdomen very minutely but feebly and densely punctate.

Legs, very slender. The eyes of the female are slightly smaller than those of the male, and the joints of the antennæ somewhat shorter and thicker. Medium large species: 4.5 – 5.5 mm.

11308. **Isomira variabilis** (Horn). (Trans. Amer. Ent. Soc. V, 1875, p. 156). – A western species, fairly common in Washington State. Many specimens from Salmon Arm, British Columbia (collected by Dr. H. B. Leech, June 12, 1934) are in the authors' and also in the Mackenzie collection. Two specimens from Trout Lake, B.C. (by E. Hamling, June 23, 1942), one from Lake Arrowhead (June 10, 1939) and Mt. Wilson, Calif. (June 15, 1940) collected by and are in the Mackenzie collection. No specimens reported recently from California (Horn, l. c.: "Occurs rather abundantly all over California").

The head is nearly evenly convex, finely punctate; eyes small; antennae slender, filiform, and half as long as body. The prothorax is about two-thirds wider than long, and gradually narrowed from base to apex; sides broadly rounded anteriorly; disc densely and rather finely punctate. The elytra are approximately three and one-third times longer than is the prothorax, one-third to one-half wider in the center, and somewhat rounded at apex. The disc shows scarcely a trace of impressed striae.

Abdomen minutely punctate, the metasternum coarsely and rather densely so; prosternum dull and very densely punctured. The legs are pale and slender.

In the male the eyes are separated by about three times their width. – Fairly large species: 4.3 – 5.9 mm.

11309. **Isomira luscitiosa** Csy. (Annals N.Y. Acad. Sci., VI, November 1891, No. 2, p. 148-149). – Generally slightly broader behind, rather narrowly oval, dull, dark piceous brown with blackish portions on the anterior; pubescence fine, short, moderately dense. The head evenly convex, very densely, rather coarsely punctate; eyes very small and unusually convex. The antennae are filiform, slender, three-fifths as long as the body. The prothorax is three-fourths wider than long with broadly rounded sides which are almost straight and parallel toward the base; disc extremely densely punctate, the punctures rather coarse. Elytra about three times as long as the prothorax, and, at or behind the middle, nearly one half wider, the two bases equal; apex rather abruptly but acutely rounded; disc finely but distinctly punctate, without trace of impressed striae. Legs slender, moderate in length, the basal joint of the hind tarsi shorter than the remainder. Small species: 4.0 – 4.3 mm in length.

Seven specimens in my collection from southern California: Lake Arrowhead, San Gabriel Canyon, Azusa and Mt. Wilson are

the localities. During May and June on wild flowers. Four specimens from the same locations are in the Mackenzie collection.

11310. **Isomira pulla** (Melsh.) — (Proc. Ac. Phil., III. 1846, p. 60.). — This is an eastern species, ranging from Rhode Island to North Carolina. My collection contains four specimens from Tampa, Florida, the southernmost recorded point of its distribution. Four specimens in the Mackenzie collection from Baltimore, Maryland (June 16, 1909, collected by F. E. Blaisdell).

The head of *I. pulla* is finely and very densely punctate, the surface almost flat; eyes small; antennae slender, about half as long as the body. The prothorax is three-fourths wider than long, strongly narrowed from base to apex, with almost evenly arcuate sides. The apex is more than one half as wide as the base, the latter being transverse, the angles right, not distinctly rounded. Elytra nearly three times longer than the prothorax, and beyond the middle nearly two-fifths wider. The base is equal in width to the thoracic base. Apex moderately acute, the disc punctured and with subsutural striae nearly as in *I. sericea*, but the punctures are slightly coarser and a little sparser. — Length 5.0 — 5.5 mm.

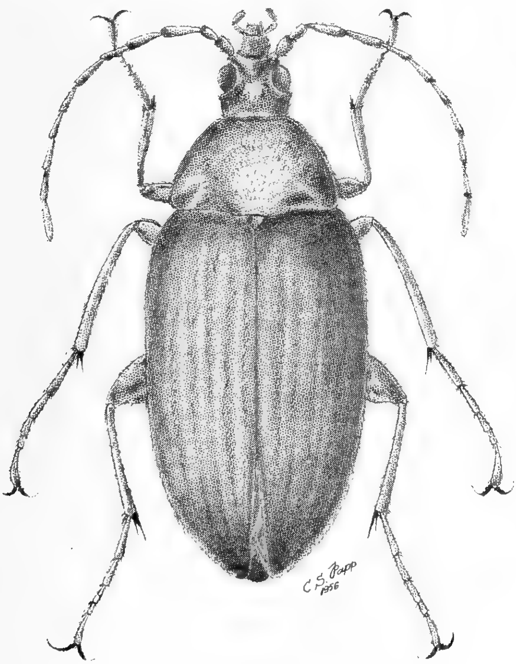

PLATE 34
Isomira comstocki. Enlarged X14

—— **Isomira comstocki** new species. — Small, narrowly oval, head dark, prothorax slightly red-brown, elytra with very fine pale yellow pubescence.

Head brown, finely and very densely punctate, the surface almost flat, slightly elevated between the eyes where the punctuation is heavier and the color black or blackish brown. Antennae filiform, about half as long as the body.

Prothorax wider than long, strongly narrowed from base to apex. The base and a longitudinal depression in the middle of the prothorax, reddish-brown.

Elytra more than three times longer than the prothorax and wider at the shoulders than the middle, then becoming broader and at the apex moderately rounded. Pale yellowish-brown in color, and slightly blackish-brown near the scutellum. Disc densely rounded, with four striae running continuously from shoulder nearly to the apex. Surface pale, with yellowish-brown pubescence.

Abdomen dark brown, finely punctate and shining. Legs are long and slender, light brown in color.

Length: 4.5 – 5.0 mm.

Holotype: Santa Rita Mountains, Madera Canyon, Arizona, August 2, 1954, collected by Dr. J. A. Comstock, to be placed in the coleoptera collection of the Los Angeles County Museum, Department of Entomology.

Paratype No. 1: Same locality, July 30, 1954 to be placed with the California Academy of Science, San Francisco, California.

Paratype No. 2: Same locality, August 2, 1954, at present retained in the collection of the author.

The holotype and paratypes were collected by Dr. John Adams Comstock, to whom I dedicate the species.

The new species is intermediate between *I. pulla* (Melsh.) and *I. quadristriata* Coup.

11311. **Isomira quadristriata** Coup. (=velutina Lec.). (The Canadian Nat., 1865, p. 62. – Casey, Annals N.Y. Acad. Sci., VI, Nov. 1891, No. 2, p. 149-150). – A northern species, widely distributed from Canada (vicinity of Lake Superior) to North Carolina. Two specimens in my collection are from Rochester, N.Y. (July 3, 1947, collected by F. C. Fletcher) and three examples from Oswego, N.Y. (July 27, 1951, of my own collecting). Six specimens in the G. P . Mackenzie collection from Midland, Michigan (June 14, 1936, June 8, 1939 and June 14, 1940), Minnesmagua Lake, Ontario, Canada (July 13, 1938, collected by B. S. Bullock) and two examples from Yellowstone, Wyoming (June 13, 1938, collected by G. P. Mackenzie).

Head feebly and evenly convex, densely punctate, rather shining; eyes small; antennae filiform, half as long as the body. Prothorax nearly twice as wide as it is long, apex rather wide, two-thirds as wide as the base, the latter being transverse, very broadly and feebly arcuate towards the middle. Disc finely, deeply and more or less densely punctate. The basa fovea are almost obsolete. Elytra four times as long as the prothorax. one-fourth wider near the middle, and narrowly rounded to the apex. Disc finely and deeply, although sparsely punctate, with only the vaguest traces of impressed striae, except the two sutural, which become very pronounced toward the apex.—Larger species: 5.0 – 5.75 mm long.

Following is a list of all species of the genus *Isomira* Muls., found in the United States and Canada, separated into two distinct groups:

GROUP A:

Elytra without distinct series of punctures

11304	*iowensis* Csy.	– Iowa
11305	*discolor* Csy.	– California
11306	*tenebrosa* Csy.	– New York
11307	*sericea* (Say)	– Massachusetts to Carolina
11308	*variabilis* Horn	– California and Washington
11309	*luscitiosa* Csy.	– California
11310	*pulla* (Melsh.)	– Rhode Island to N. Carolina
11310½	*comstocki* Papp	–Southern Arizona (Santa Rita Mt.)
11311	*quadristriata* Coup. (syn. *velutina* Lec.)	– Southern Canada to N. Carolina and Indiana
11312	*similis* Blatch.	– Indiana
11313	*monticola* Csy.	– California
11314	*oblongula* Csy.	– New York and Indiana

GROUP B:

Elytra with series of more or less complete and sometimes feebly impressed small punctures.

11315	*valida* Sz.	– Florida
11316	*texana* Csy.	– Texas
11317	*ruficollis* Ham.	– Pennsylvania
11318	*ignora* Blatch.	– Florida

DESCRIPTION OF A NEW SUBSPECIES OF THE MEGATHYMUS YUCCAE (BOISD. & LeC.) COMPLEX.

(Lepidoptera, Rhopalocera, Megathymidae.)

Don B. Stallings & J. R. Turner, *Caldwell, Kansas.*

For a number of years the subspecies of *Megathymus yuccae* that feeds on *Yucca brevifolia* Engelm. in California has been called *Megathymus yucca navajo* Skin. Actually *navajo* is a much smaller subspecies (type locality is in the Zuni Mts. of N. Mex.) that occurs in parts of N. Mex., Ariz. and Colo. The California subspecies being unnamed we describe it herewith:

Megathymus yuccae martini new subspecies

FEMALE. Upper surface: Primaries: Grey black with the base having only the faintest indication of sordid yellowish scales and hairs. Spot 1 (cell spot) is rectangular and curves slightly inward at each side. Spots 2, 3 & 4 (subapical spots) white and rather large, compared to the males. Spots 5 and 6 (submarginal spots) are out of line with the remaining three marginal spots (7, 8 & 9). Spots 7, 8 & 9 are larger, average 5 mm. across. Spot 9 is pointed inward, whereas 7 and 8 are broadly rectangular and slightly rounded on the inner side. All spots (except 2, 3 & 4) are pale yellow. Fringes: Alternately checkered greyish and black. Secondaries: Grey black with some light greyish hairs near the base. There is a broad greyish marginal border with veins edged in black. Spots 10, 11, 12 & 13 greyish yellow. Spots 12 and 13 are usually well defined. Spots 10 and 11 are much smaller and in some cases one or both are not present. These two spots (10 & 11) are placed inward nearer the base and thus are out of line with 12 and 13. Fringes: Grey with only the veins edged in black. Under surfaces: Primaries: Greyish black with the outer margin grey. The spots reappear and are of the same size but somewhat lighter. Secondaries: Greyish black over the center portion, becoming greyer near the outer margin. Costal region grey. The two white spots below the costal margin are about the same size, except the outer one is more linear. Abdomen: Dark grey above, somewhat lighter beneath. Thorax: Grey above, brownish-black below. Palpi: Sordid White. Antennae: Club black above, lighter beneath, remaining portion greyish, slightly ringed with black. Expanse of forewing varies from 26 mm. to 33 mm., average 31 mm. Wing measurements of Holotype: Forewing, apex to base 33 mm., apex to outer angle 19.5 mm., outer angle to base 23 mm. Hindwing, base to end of vein Cu_1 23 mm.

MALE. Upper surface: Primaries: Grey black with the base of the wings tinted with yellowish hairs and scales. The tip of the apex is grey. Spot 1 is small, pale yellow to chalky white. Immediately above this is a small white area usually smaller than the spot below. Spots 2, 3, & 4 white. Spots 5 and 6 out of line, nearer outer margin and very pale yellow in color. Spots 7, 8 & 9 are larger and are of the same pale yellow to chalky white color as spot 1. Fringes checkered black and white. Secondaries: Grey black with base tinted with yellowish scales and hairs. There is a medium sized marginal border, pale yellow to chalky white (almost a bluish cast). The veins in this marginal area are faintly outlined in black. Under Surface: Primaries: Brown black with apex and outer margin grey. The spots are all white or chalky white, the lower 3 marginal spots having only the slightest yellowish cast. Secondaries: Basal areas brown black, with remainder of wing grey. There is a well defined costal area near the base and beneath it two white spots. The inward spot being developed and triangular in shape, the outward spot a thin crescent curved outwardly. Abdomen, Thorax, Palpi and Antennae very similiar to female. Expanse of forewing varies from 23 mm. to 28 mm., average 26 mm. Wing measurement of Allotype: Forewing, apex to base 27 mm., apex to outer angle 15 mm., outer angle to base 18 mm., hindwing, base to end of vein Cu_1 16.5 mm.

Described from 76 specimens, 40 males and 36 females. All of these specimens were collected by Dr. John A. Comstock, Lloyd M. Martin and Frank Sala at or near Little Rock, L.A. County, Calif. either as pupae or adults during January, February and March, except two which were collected at Whittier, Calif., by Lowell Hulbirt.

Holotype: March 23, 1945 (Lloyd M. Martin) Little Rock, Los Angeles County, Calif. and Allotype, Feb. 23, 1939 (Lloyd M. Martin) same location, are in the collection of the authors. 15 male and 15 female paratypes are in the Los Angeles County Museum; one pair of paratypes in the San Diego Museum; one male paratype in the collection of F. Martin Brown; one pair of paratypes in the collection of Lowell Hulbirt. 10 male and 8 female paratypes in the collection of H. A. Freeman. The remaining paratypes in the collection of the authors.

The females of *M. yuccae martini* can be distinguished from all other subspecies of *yuccae* by the following characters: Grey-black coloration with the pale spots, the greyish marginal border of the secondaries and the very indistinct, irregularly shaped band

of spots on the secondaries. The basic characterictics of the males are their grey-black coloration and chalky white to pale yellow spots.

We name this subspecies in honor of Lloyd M. Martin who has been most patient with our many requests for information and data. The life history of this subspecies has been fully reported by Comstock and Dammers, ("Bulletin of the Southern California Academy of Sciences," Vol. XXXIII, May-August, 1934, Part 2, p. 79, 87-92). See also "Quarterly of the Los Angeles County Museum," Vol. VI, No. 2 (Summer, 1947) page 12 for further life history data, including pictures of type locality. Tinkham pictures both surfaces of both sexes in his recent paper "Bulletin of the Southern California Academy of Sciences," Vol. 53, Part 2, Pg. 75, 1954, describing *Megathymus yuccæ arizonæ*. Due to the fact that this paper had not been published he refers to *martini* as *navajo*.

Due to the fact that the species and subspecies of *Megathymus* appear to have definite food preferences we apply the name *martini* only to the feeders on *Yucca brevifolia*, for the time being.

ANALYSIS OF VARIATION IN A RECENTLY EXTINCT POLYMORPHIC LYCÆNID BUTTERFLY, *GLAUCOPSYCHE XERCES* (Bdv.), WITH NOTES ON ITS BIOLOGY AND TAXONOMY

By J. C. DOWNEY[1] AND W. H. LANGE, JR.[2]

The holarctic genus *Glaucopsyche* is represented in North America by only two species: *G. lygdamus* (Doubl.), of widespread occurrence throughout the United States and Canada, and *G. xerces* (Bdv.), previously restricted to narrow limits on the San Francisco peninsula in California. Our records indicate that the last known specimens of *G. xerces* were collected at the Presidio in San Francisco during May, 1941. Since that time numerous lepidopterists have made many collecting trips to the areas in San Francisco where, for at least two prior decades, the only known population of this species had existed. We are of the opinion that it is extinct.

Population systematists have long been interested in the effects of population size and geographical distribution on infra- (and intra-) specific variation. But for its untimely extinction, *G. xerces* would have made a unique tool for studies of this type. It was so limited in distribution that any individual was geographically within flight range of its contemporaries. In this sense it could be considered a species consisting of but one population. Equally important, the wings exhibit extreme continuous and discontinuous variation in macular components. Unfortunately, little information has been recorded in the literature, and it was felt that the following observations on the biology and variation would be of value.

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Glaucopsyche xerces (Bdv.)

Lycaena xerces Bdv. 1852, Ann. Soc. Ent. France, p. 296; Edwards 1872, Synopsis No. Amer. Butt., p. 35; Strecker 1874, Lepid. Rhop. and Heter., p. 86; Edwards 1877, Cat. Lepid. Amer. No. Mex., p. 45; Strecker 1878, A Complete Syn. Cat. Macrolepid., p. 96; Edwards 1884, Revised Cat., p. 303; Maynard 1891, Manual No. Amer. Butt., p. 158; Skinner 1898, Syn. Cat. No. Amer. Lepid., p. 55; Smith 1903, Check List Lepid. Boreal Amer., p. 8; Skinner 1905, A Syn. Cat., Suppl. No. 1, p. 19; Williams 1908, Ent. News, p. 476; Williams 1910, Ent. News, p. 38; Skinner 1914, Ent. News, p. 326; Skinner 1917, Ent. News, p. 214; Huguenin 1918, Ent. News, p. 392; Wright 1906, Butt. West Coast, p. 222, and pl. 29, figs. 370, (370)b, (370)c; Draudt 1924, *In* Seitz Macrolepid., p. 815, pl. 144 row C; Holland 1930, Butt. Book (Rev. Ed.), p. 261, pl. 65, figs. 41, 42, pl. 30 fig. 43.

Lycaena antiacis Bdv. 1852, *op. cit.*, p. 300; Edwards 1872, *op. cit.*, p. 37; Strecker (*in part*) 1874, *op. cit.*, p. 84; Edwards 1877, *op. cit.*, p. 46; Strecker 1878, *loc. cit.*; Edwards 1884, *loc. cit.*; Maynard (*in part*) 1891, *loc. cit.*; Skinner 1898, *loc. cit.*; Smith 1903, *loc. cit.*; Skinner 1905, *loc. cit.*; Williams 1908, *loc. cit.*; *idem.*, 1910, *loc. cit.*; Skinner 1914, *loc. cit.*; Huguenin 1918, *loc. cit.*; Draudt 1924, *op. cit.*, p. 816, pl. 144 row C.

Polyommatus xerces, Morris 1860, Smiths, Misc. Coll., p. 12; *idem.*, 1862, Diurnal and crepuscular Lepid., p. 88.

Polyommatus antiacis, Morris 1860, *loc. cit.*; *idem.*, 1862, *op. cit.*, p. 90.

Lycaena mertila Edw. 1866, Proc. Ent. Soc. Philad., p. 206; Strecker 1874, *op. cit.*, p. 85; Wright 1906, *loc. cit.*

Lycaena polyphemus Bdv. 1869, Ann. Soc. Ent. Belg., p. 49.

Cupido xerces, Kirby 1871, A Syn. Cat. Diurnal Lepid., p. 373.

Cupido antiacis, Kirby 1871, *op. cit.*, p. 371.

Cupido polyphemus, Kirby 1871, *op. cit.*, p. 373.

Glaucopsyche lygdamus (Doubleday) of Scudder (*in part*) 1873, Proc. Boston Soc. Nat. Hist., p. 198; Wright 1906, *op. cit.*, p. 221 and pl. 29, figs. 367, (367)b, (367)c.

Nomiades xerces, Scudder 1876, Can. Ent., p. 21; *idem*, 1876a, Syn. List Butt. No. Amer., p. 117; Dyar 1902, Bull. U. S. Nat. Mus., No. 52, p. 43; McDunnough 1914, Ent. Rec., p. 200; Skinner 1917, Ent. News, p. 214.

Nomiades antiacis, Scudder 1876, *loc. cit.*; *idem*, 1876a, *loc. cit.*; Dyar 1902, *loc. cit.*

Lycaena behri (*partim auct. nec.* Edw.) *vide* Scudder 1876, *op. cit.*, p. 24; Strecker (*in part*) 1878, *loc. cit.*, p. 97.

Lycaena antiacis var. *behrii,* Edw. 1877, *op. cit.*, p. 46.

Lycaena antiacis var. *mertila,* Edw. 1877, *loc. cit.*

Lycaena antiacis polyphemus, Edw. 1877, *loc. cit.*

Nomiades antiacis behrii, Dyar 1902, *loc. cit.*

Nomiades antiacis mertila, Dyar 1902, *loc. cit.*

Glaucopsyche xerces, Barnes and McDunnough 1916, Cont. Lepid. No. Amer., 3, p. 117; idem, 1917, Check List Lepid. Boreal Amer., p. 17; Comstock 1927, Butt. of Calif., p. 199, pl. 56, figs. 30, 31; McDunnough 1938, Check List . . . Macrolepid., p. 28.

Glaucopsyche xerces polyphemus, Comstock 1927, *op. cit.,* p. 200, pl. 57, figs. 1, 2.

Glaucopsyche xerces mertila, Comstock 1927, *loc. cit.,* pl. 57, fig. 4.

Glaucopsyche xerces mertila ab. *huguenini,* Gunder 1925, Ent. News, p. 3, pl. 1, figs. 00 and 0; Comstock 1927, *loc. cit.,* pl. 57, fig. 5.

Glaucopsyche xerces mertila tr. f. *barnesi,* Gunder 1927, Can. Ent., p. 282, pl. A, figs. 2, 2a and 2b.

Glaucopsyche xerces ab. *antiacis,* Comstock, *loc. cit.,* pl. 57, fig. 3.

The complete synonomy listed above is based on available literature and not actual specimens. It is quite possible that in certain instances the catalogues and other compilations mentioned may have been in error in the application of the name. Lacking the specimens available to these early revisors (if indeed some of them actually saw the specimens), we cannot certify to the validity of the usage of the name. Quite understandably, with but few specimens before them, early workers were often misled by the extreme color polymorphism exhibited not only in *xerces* but in many of the species in the subfamily. The two species most likely to have been confused with *xerces* are *Glaucopsyche lygdamus* (Dbldy.) and *Icaricia icariodes* (Bdv.), both of which are polytypic and have numerous subspecific categories. *G. xerces* has been reported as far north as British Columbia (Blackmore, 1920), as far east as Nebraska (Cary, 1901) and Colorado (Mead, 1875) and in southern California (Simms, 1920). This adds to the synonomy of the species involved in these areas, but the occurrence of *G. xerces* outside of the San Francisco region has not been verified.

NOTES ON BIOLOGY

The life history of *G. xerces* has been previously described (Williams, 1908). The reader is referred to that work for detailed descriptions of the egg, the four larval instars, and the pupa, Drawings of the immature stages can also be found in Comstock (1927). The following are notes and comments on the species as recorded in the literature and from observations in the field and on larvae raised by Lange between 1939 and 1941.

Williams states that the "usual" food plant is *Lotus glaber* Greene (= *L. scoparius* [Nutt.] Ottley), a prostrate, bushy perennial. One larva was discovered on *Lupinus arboreus* Sims, a tall perennial with yellow flowers. He noted that confined larvae "readily devoured" leaves and seed pods of *Lupinus micranthus* Dougl. and *Astragalus menziesii* Gray.

In March, 1939, Lange found eggs on the first two species mentioned above, and on a small, blue flowered *Lupinus* sp. (*micranthus*?). He examined ten plants of *L. arboreus* varying in height from one to three and one-half feet. A total of twenty eggs were found; some plants had as many as eight eggs per plant. Five plants had no eggs. In the same area on the same day, ten specimens of *Lotus scoparius* were examined, varying in diameter from one to three feet. Thirty-four eggs were discovered with as many as nine eggs per plant. Only one plant had no eggs. The *Lotus* would appear to be slightly favored with an average of 3.4 eggs per plant compared to 2 eggs per plant for the *Lupinus*. Unfortunately, no information could be obtained on the possible effects of the different food plants on the variation.

Some measurements of the egg were taken. The width varied from 0.53 to 0.70 mm.; height range was from 0.36 to 0.40.

During oviposition on *L. arboreus* the female alighted, brought the abdomen forward, and placed an egg in the small depression at the base of the leaflet. On *Lotus scoparius*, however, the eggs were laid on the new growth near the tips of the leaflets or on the dorsal surfaces of the new growth. Coolidge (1913) states that he has had success in obtaining eggs from gravid females in captivity. Apparently the reactions of *G. xerces* were similar to other lycaenids under laboratory conditions.

Williams (*loc. cit.*) reported that the larvae of *G. xerces* are distinguishable from those of *G. lygdamus behrii* (Edw.) but, beyond mentioning that *behrii* larvae are broader, gave only minor color criteria. Elsewhere Williams points out that the general color pattern of both species is similar in both larval and pupal stages. In addition, the larval color seems to be variable in both species. More striking similarity between the early stages of both species can be noted by comparing Williams' description with that given by Bower (1911) for *G. lygdamus* from Illinois. If a structure by structure comparison is made in chart form, neglecting the factors of color, the similarity would raise the question of conspecificity. Bower, however, records five larval instars for *lygdamus* while *xerces* has only four. It is known that temperature can affect the number of instars. Williams also notes a row of short supra-stigmoidal clavate hairs not discussed by Bower. This similarity in the two species, plus that noted in the genitalia and in the macular pattern, indicates a much closer phylogenetic relationship than heretofore assumed.

Forty-eight days elapsed from the time the eggs hatched until pupation, in the specimens raised by Williams. Those raised by Lange took thirty-one days. Again, temperature at which the larvae were raised could account for the difference in time.

As is common to many of the Lycaenidae, the larvae of *G. xerces* are tended by ants. They bear a secretory gland on the tenth segment and a pair of eversible sacs on the eleventh segment. Using Balduf's (1939) classification of entomophagous insects, they are hereby considered facultative myrmecophiles. As evidenced by successful laboratory rearings, they are not completely dependent on ants for their welfare. Tilden (1947) records the occurrence of the pupa of *G. lygdamus behrii* (Edw.) in an ant nest. And almost every mature larva of the Illinois subspecies of *G. lygdamus* was tended by ants, according to Bower (1911). Bower also reports cannibalism in *lygdamus*. Downey has reared *G. lygdamus* from Utah without ants. Apparently the genus is associated in nature with ants, but the relationship is not mandatory.

Three unidentified hymenopterous parasites were found preying on the larva by Williams (*loc. cit.*, p. 482). An ichneumon was also reared from the pupa by the same author. All the parasites emerged the same season.

Length of pupal life averages between ten and eleven months. However, adult emergence seems to be influenced by environmental factors. Of the specimens raised by Williams in a warm, dry room, one emerged in mid-winter; others came out the following year "... quite late as compared with *xerces* in nature". Two adults in our series are marked "ex egg, Lake Merced, San Francisco" by E. J. Newcomer. Both were raised in Palo Alto, California. A male emerged November 2, 1909, a female November 4, 1909.

On July 26, 1941, Lange searched for pupae in the area where eggs were previously discovered that year. No pupae could be found on the plants, in the detritus below the plants, or in the ground.

The major flight period of the adult is from about March 10 to April 15. However, specimens may be taken from late February to early June.

On March 19, 1919, the only population noted by Lange was flying in a limited area west of the Marine Hospital, Presidio, San Francisco. He observed pairs mating on *Lupinus arboreus*, and two mating pairs were preserved. One pair was an *antiacis* male crossed with a *xerces* female, and the other pair was the reciprocal. These are shown on plate 36. Since two such matings were observed in one day, it would suggest that there is no selective mating of macular types. Huguenin (1918) has also reported *antiacis-xerces* crossing, and Barnes and McDunnough (1916) picture a bilateral heteromorphic female; *antiacis* on one side, *xerces* on the other. These facts verify the synonomy presented above.

Lange made another series of observations in the same area on March 23, 1941. The butterflies were limited to a small area 65 feet wide by 140 feet long in which *Lotus scoparius* was found. The *Lotus* occurred in patches in the partial shade of the Monterey Cypress (*Cupressus macrocarpa* Hartw.) in well-drained sandy soil. *Lupinus arboreus* was widely distributed among the *Lotus*, and extended beyond the range of the *Lotus* and the butterflies. It is of interest that this same association of plants remains essentially unchanged today. There are other areas on the San Francisco peninsula where this situation can be found. Howell (1949) states that these species of *Lotus* and *Lupinus* are common in sandy areas in Marin County (just north of San Francisco). Monterey cypress, however, does not occur there. Expansion of the city of San Francisco has destroyed much natural habitat formerly available to insects in the area. However, it would seem that sufficient ecological niches remain so that diminishing habitat could not be the single cause of the extinction of *xerces*. What effect collecting pressures had on the species is also a debatable point, but it is doubted that it had any beneficial effect on the survival of the species. Physical factors, particularly temperature and humidity, are much more static on the peninsula than in regions more remote from the meliorating effects of the prevailing westerly winds off the ocean. Thus, the climate of this coastal region tends to be warmer in the winter and cooler in the summer than inland areas. The effect of a sudden shift in amplitude of these rather narrow annual climatic oscillations might have been greater on *xerces* than on comparable numbers of another species in another area where the "normal" yearly fluctuations are more extreme.

Maculation

The results of a general analysis of the macular pattern in *G. xerces* are partially summarized in table 1; the "typical" spot arrangement is shown on plate 35, figure 6.

"Typical" spotting of the undersurface was determined by the frequency of combinations of spots as well as by the frequency with which a given macule occurred. Three hundred forty-four specimens were examined. The following macules belong to the "typical" set: forewing, RM, R4, M1, M2, M3, CU1, and CU2 + 1A (fused); hindwing, SC2, M, RM, SC1, RS, M1, M2, M3, CU1, CU2 + 1A, and 2A. Of the individuals examined, 33.7 per cent had these spots, and the others had varying combinations of missing or additional macules, only a few of which exhibited any degree of consistency.

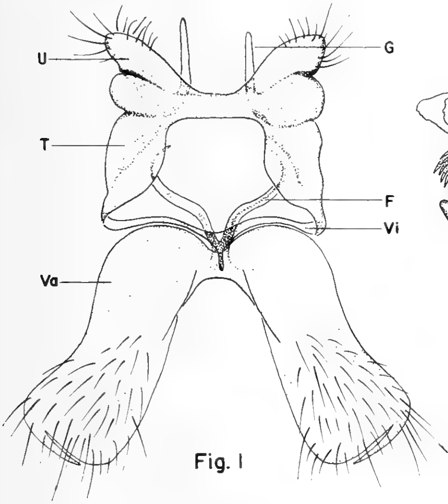

Fig. 1

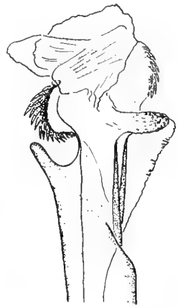

Fig. 2

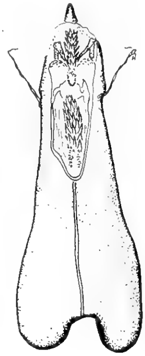

Fig. 3

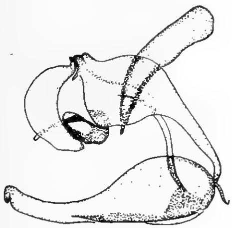

Fig. 4

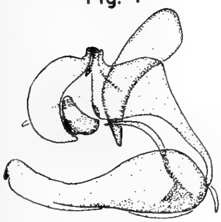

Fig. 5

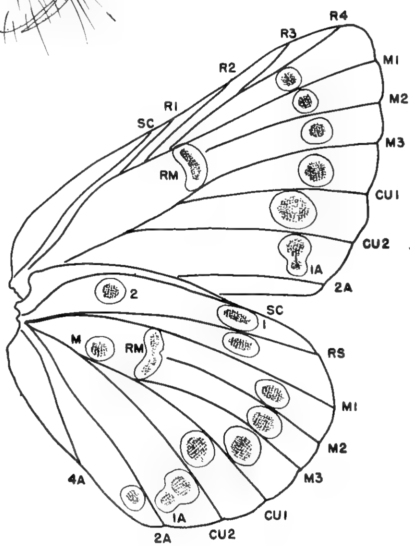

Fig. 6

PLATE 35

Fig. 1. Distended view of genitalia of *G. xerces* (Bdv.); the ædeagus has been removed and the entire structure is somewhat flattened.

F=furca	U=uncus
G=gnathos (=falx)	Va=valvae
T=tegumen	Vi=vinculum

Fig. 2. Lateral view of distal part of aedeagus with everted vesica. Note one group of cornuti on both the dorsal and ventral surfaces.

Fig. 3. Dorsal view of aedeagus with vesica in normal position and cornuti visible.

Fig. 4. Lateral view of genitalia of *G. lygdamus behrii* (Edw.) from Berkeley Hills, Alameda Co., California.

Fig. 5. Same view, *G. xerces* (Bdv.) from San Francisco, California.

Fig. 6. "Typical" spot pattern of undersurface of wings of *G. xerces* as determined by analysis of three hundred forty four specimens (see text). The macules are designated by the names of the veins above them, except those specifically marked.

Wing Condition		Sex ♂♂	♀♀
Number Examined		226	118
"Typical" Spotting		71 (31.4)	45 (38.1)
Aberrations		7 (3.0)	1 (0.08)
Additional Macules		22 (9.7)	11 (9.3)
Total Missing Macules	Fore-wing	57 (25.2)	16 (13.5)
	Hind-wing	141 (62.3)	59 (50.0)
Missing more than one macule		78 (34.5)	14 (11.8)
Mertila Dash		65 (28.7)	32 (27.1)
Under-surface ground color	Light	21 (9.5)	15 (12.8)
	Inter.	55 (25.1)	30 (25.6)
	Dark	143 (65.3)	72 (61.5)

Table 1. Macular components and undersurface ground color of wings of *Glaucopsyche xerces* (Bdv.). Percentage values for each sex are listed in parenthesis under the number of individuals showing the condition.

In the original compiling of these data we treated as units those individuals of the species that could be grouped under the older taxonomic designations of "antiacis", "xerces", and "polyphemus". Since the white streak characteristic of the form "mertila" had the same frequency of occurrence in all the named varieties (28 per cent), it was not utilized in the major macular groupings, and it was not counted as being "typical" or "atypical" for purposes of macular computations as listed on the chart.

When the data for the three groups were compared, [it was evident that] no significant difference in frequency of macular groupings or individual macules could be detected. This gave additional evidence that only one taxonomic entity was being treated, and further suggested that the presence or absence of spots is under genetic control, while the absolute size of the spots may be environmentally affected. This view is also held by Brower and Brower (1954) in their work in the subfamily Lycæninæ. Of the 33.7 per cent showing the "typical" pattern, no division is made of the number of individuals having large or small macules, or pupiled on non-pupiled spots.

The maculation of the hindwing is more variable than that of the forewing. Spot 1A was missing in 21 per cent of the individuals and, with the exception of two specimens classified as aberrations (shown on plate 37), was the only spot missing from the macular pattern of the forewing. Whenever spot 1A was absent in the forewing, spots 1A and 2A of the hindwing were also missing. Although spot 2A was missing in 49 per cent of the individuals, it is included as part of the typical pattern. It appears most often in specimens that are "typical" in regard to other macules and have more pronounced spots. Other macules missing from the hindwing are: 1A (in 107 individuals), M (in 24), CU2 (in 7), SC2 (in 5), and RS (in 3). Certain combinations appear to be missing rather frequently: forewing 1A, hindwing 1A, 2A (missing in 73 individuals), the same combination +M (in 12), SC2 and M (in 3), 2A and M (in 14), and CU2 and 1A (in 7).

The upper surface shade of blue in the males is also quite variable. It is influenced by many factors including the wear of the specimen; fuscous infusion, particularly in distal areas and along wing veins; white scales on wing veins; and light. No discontinuous variation could be noted, even though cognizance of these factors lessened the subjectiveness of the judgment. In general it may be stated that the blue of the males is of a lighter shade than that found in adjacent races of *G. lygdamus*. Similarly, the brown of the female upper surface exhibits continuous variation. In all females, however, there was a basal infusion of blue scales on the upper surface, which, depending on its extent, greatly affected the gross color.

WING LENGTH

Wing length measurements were taken with a Cenco Vernier caliper and recorded in millimeters. In the forewing they were taken from the base of vein CU to the end of M1. The hindwing

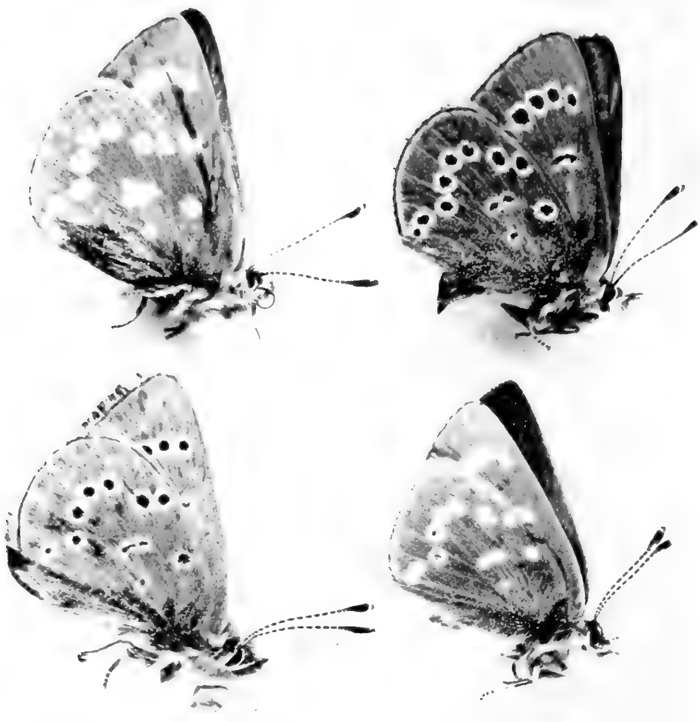

PLATE 36

Mating pairs of *G. xerces* (Bdv.); males on the left, females on the right. Crosses are reciprocal for pupiled versus non-pupiled macules.

was measured from the base of CU to the end of M2. The following average lengths were established: male, forewing 16.2 (maximum 18.0, minimum 13.0), hindwing 12.6 (max. 14.0, min. 9.0); female, forewing 15.8 (17.8, 14.0), hindwing 12.5 (14.0, 10.2). No difference in size range could be found among the named forms, and no shape difference could be detected in the specimens examined.

An attempt was made to compare the frequency of macules, macular groupings, and named "forms" with environmental factors, but no definite conclusions could be deduced. Williams (1908) has suggested that the environment probably "produces" the variability in *xerces*, and Standfuss (1895) and others report that some species in the Lycaenidae show adult color aberrations when the later instar larvae are exposed to different temperatures. Collections of *xerces* for any one year were not sufficient in numbers to determine possible effects of temperature on specimens taken early or late in the flight period. Also, selective collecting by the numerous lepidopterists contributing material might have made the data questionable. However, 56 specimens taken in 1907 and 1909 were compared with 59 specimens taken in 1931 and 1932. The same range of variability in size of wings, color, frequency of individual macules, and macular combinations was shown in both. The only striking difference was the percentage increase of the form *xerces*, from 21 per cent of the individuals taken in the early years to 45 per cent in the later group. Again, selective collecting may have influenced these figures. No environmental feature could be related to this increase. Garth (1932) collected several populations of *G. lygdamus australis* Grin. in Riverside County, California, each of which exhibited different frequencies of macular components.

As early as 1884, *xerces* was believed to be extinct (see Edwards 1884, p. 303). In 1906 Wright (p. 222) also reported *xerces* was "lost for 30 years"; of course both authors considered it distinct from *antiacis* and make no mention of the latter being "lost". This suggests the *xerces* form to have been in the minority for at least the last two decades prior to 1900. Williams (1910) states that *xerces* was rare in that year, although formerly abundant, and that *antiacis* was more common that *xerces*. Skinner (1914) reports one year, presumably 1913, an unusual ratio of one-third *antiacis* to two-thirds *xerces* was observed. Huguenin had sent the information and specimens to Skinner and told him that for twenty-five years preceding that time, the reverse ratio had been found. Williams (1908) reared sixteen larvae, all of which emerged *antiacis*. Lange reared one adult in 1940: it was

form *xerces*. These observations are interesting, but without breeding experiments, the ratios cannot be evaluated as being either of genetic or environmental control.

Our material shows 36 per cent *xerces* forms and 63 per cent pupiled individuals, and, as such, might be an accurate proportional assemblage of variable forms, as found in nature, even though collected over many years.

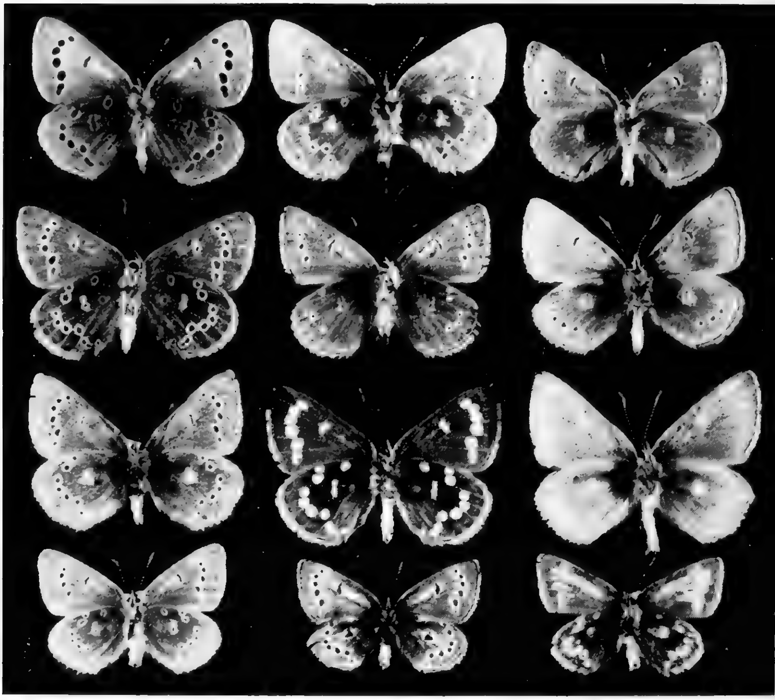

PLATE 37

Variation range in wing characters of undersurface of male wings in *G. xerces* (Bdv.). The pupiled macules of the specimen in the upper left hand corner is typical of what has been called "antiacis." The unpupiled form "xerces" is shown in the middle row, third specimen. Specimens between the two types have been previously designated under the form name "polyphemus" or, if they have a white dash in the discal cell of the forewing, under the form name "mertila." For purposes of macular analysis (see text), specimens shown in the last row have been classified under aberrations.

GENITALIA

Figures 1, 2, 3 and 5 on plate 35 show the detail of the male genitalia. Individual specimens exhibit some degree of size variation, but the extremes have the same ratio of component parts. As in the wing studies, preliminary measurements for forms *antiacis* and *polyphemus* and for form *xerces* were kept separate. Statistical analysis indicated that they could not be distinguished on the basis of the measurements taken. This fact not only verifies the synonomy presented but proves that within a population the genitalia are less plastic than are wing characters.

Only a few structures of the genitalia were conducive to accurate measurement. The subjectiveness of other measurements was increased by curvature of the parts and difficulties arising from artifacts of slide preparation. The latter structures are omitted from this report. The following data were obtained on twenty-two specimens. Valve length was measured on the longest axis of the medial surface, and width was taken at the widest distal portion of the valve at right angles to the longitudinal axis. All measurements are in millimeters. Mean valve length 1.45, maximum 1.62, minimum 1.26; mean valve width 0.609, max. 0.664, min. 0.556; mean length aedeagus 1.06, max. 1.17, min. 0.86. Valve length showed no proportional increase with increase in length of wing, but seemed to vary independently.

The genitalia of *G. xerces* are very similar to those of *G. lygdamus* (Dbldy.). On the basis of the male genitalia alone, *xerces* should be assigned subspecific status under *lygdamus*. However, there are differences between these species in larval stages, adult wing maculation, and ecology. In addition, occasional specimens of *G. lydamus behrii* (Edw.) are taken in the areas where *xerces* occurred, and hybrids have never been detected. We are of the opinion that they are closely related but separate species. Figure 4 on plate 35 is a lateral view of *G. lydamus behrii* (Edw.), which can be compared with *G. xerces* in figure 5. Here it can be noted that *G. xerces* possesses a slightly wider uncus fold. There are minor differences in the basal portion of the gnathos, and the dorso-cephalic part of the tegumen in *G. xerces* has a more marked ventral curvature to its junction with the vinculum. The aedeagus of *xerces* is somewhat shorter and stouter than in *lygdamus*. Valve length is greater in proportion to its width in *xerces* than in *lygdamus*. Genitalia of various subspecies of *G. lygdamus* were examined from numerous widely scattered California localities, from Utah, Colorado, Arizona, Wyoming, and Nebraska, and Manitoba, Canada. As might be expected from their spatial isolation, they exhibit a greater range of variation within the taxon *lygdamus* than occurs in *xerces*.

The aedeagus in this genus is rather distinct from that found in other genera of "blues" in that the terminal portion of the ejaculatory duct bears two groups of *cornuti*. These chitinized spines are shown in their normal position, housed within the aedeagus, in plate 35, figure 3. The entire distal portion of this duct is frequently found everted, as shown in figure 2. The more membranous parts are "hinged" together somewhat like a carpenter's ruler, so that they unfold successively from dorsal and ventral fulcral points. Various stages of erection of this structure are found in slide preparations, which makes more difficult a study of its infra-specific variation.

Discussion

Recent work has shown that the extinction of a local population is not a very rare event (see Andrewartha and Birch, 1954, for a discussion). Ford (1949) has given many examples in butterflies. The only distinction to be made between the extinction of a local population and the extinction of a species is one of degree; the former always precedes the latter, but is not always followed by it. The extinction of *G. xerces* is not as unusual as the fact that the entire species consisted of but one population. One of the most evident considerations of the ecological problems confronting *xerces* prior to its disappearance would be population size.

In a sense, population density is a measure of biological success. What the maximum number would be for a given species under optimum conditions is a moot point, but the theory is generally accepted that a species is at its adaptive peak where it is most abundant. We are at a disadvantage with this species since its abundance can only be measured and compared in time, not in space. However, extreme yearly fluctuations in numbers have been recorded in the literature and are verified by the museum material available. This suggests that population numbers were a direct reflection of environmental forces. Another generally accepted biological theory is that a species is most variable at the periphery of its range of distribution. Basic to this premise are the more stringent selective forces acting on the genetic structure of the group in that area. Regarding *G. xerces,* it would seem that the entire species is the "peripheral" group, and population size is an effect and not necessarily the cause of the variability. Essentially, the species was "trying everything" in its genetic composition to become biologically successful, but no single genotype became selectively adaptive. However, we can postulate, *a priori,* that only a limited number of responses to the environment would

be left to a small population living in a fairly uniform environment. This holds true even though each stage of the life history (egg, larva, pupa, and adult) presumably has its own environmental requirements (optimum) that would make environmental pressures more subtle. The population can be thought of as an equilibrium between these numerous selective pressures, each influencing the species in a different morphological direction. No one species, particularly those consisting of but one small population, can have a maximum adaptation to all of the environmental factors.

We would like to thank the following individuals and institutions for the loan of specimens used during this study: L. M. Martin, Los Angeles County Museum; E. S. Ross, H. B. Leech, California Academy of Sciences, San Francisco.

SUMMARY

1. Information gleaned from the literature plus additional evidence presented indicates that there is one polymorphic group under the taxon *Glaucopsyche xerces* (Bdv.).

2. A listing of the synonomy based on available literature is given.

3. *G. xerces* has not been recorded since 1941 in the area where it formerly occurred and is presumed extinct.

4. Hitherto unreported aspects of its biology are presented, including oviposition, host plants, egg density, ant association, adult flight period, etc.

5. Evidence is given to show that *G. xerces* (Bdv.) and *G. lygdamus* (Dbldy.) are much closer phylogenetically than previously supposed.

6. A summary analysis of the wing variation in 344 specimens is given, from which was derived the typical maculation.

7. Drawings of the genitalia are presented for comparison with forms with which *xerces* might be confused.

8. A discussion of the variation within the taxon is given, together with comments on the probable factors related to the extinction of the species.

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NOTES ON THE LIFE HISTORIES OF TWO SOUTHERN ARIZONA BUTTERFLIES

By JOHN ADAMS COMSTOCK

INTRODUCTION

In the latter part of July, 1955, the writer made a collecting trip in southern Arizona, accompanied by Dr. Francis X. Williams.

We established camp in Madera Canyon, Santa Rita Mountains, where considerable material bearing on the life histories of lepidoptera was obtained.

In this work Francis Williams' long experience in field collecting for the Hawaiian Sugar Planters Association came into play, and many of the studies which I was enabled to carry through could not have been made but for his keen faculty of observation, and his instinctive knowledge of insect behavior.

On July 23 we decided to shift camp to Miller Canyon, in the Huachuca Mountains. It is in this canyon that the mining town of Palmerlee was formerly located. Today the town is in ruins, and few Arizonans know of its existence. Its site was of major interest to us however, as it is the type locality for many species of lepidoptera collected in the early days by O. C. Poling, and other entomological pioneers.

Miller Canyon is one of three, located on the eastern slopes of the Huachucas, all of which are of interest to lepidopterists. These three, named from north to south, are Ramsay, Carr, and Miller Canyons. All are accessible by roads.

The narrow, single-lane road traversing Miller Canyon, runs through heavy brush, then climbs through a thick forest, dominated by oaks and sycamores, to a considerable elevation, (6,100 ft.) where it ends in a small cirque of stone ruins and terraces, tucked in and partly obscured by verdure. Apparently the stone walls are mainly the remnants of former miner's cabins.

The vegetation here is varied and luxuriant, and collecting conditions ideal.

While scouting in the vicinity of camp, Dr. Williams found so many larvae of various species that the writer had to spend most of his time transcribing field notes and preparing illustrations.

Among other prizes thus obtained, a single mature larva of a large skipper was found on oak. Notes were made of this, but the specimen pupated before a drawing of the larva could be executed. A painting of the pupa was completed, and the specimen eventually gave forth a fine example of *Pyrrhopyge araxes arizonæ.*

This species of giant skipper, along with its subspecies, was described in 1893, by Godman and Salvin.[1]. In 1921, Dr. A. W. Lindsey, in referring to the subspecies[2] said "I have two bred specimens from southern Arizona".

It is much to be regretted that the collector who reared these specimens left no record of the life history or foodplant.

The only hint we have as to the metamorphosis is that by Draudt in his discussion of the genus *Pyrrhopyge.*[3] Since *araxes* is therein listed as one of the many members of that genus this reference is worth quoting. "The larvae of *Pyrrhopyge,* as far as we know, are thinly haired on the body, shaggily on the head, brown or reddish, with yellow zebra-like stripes".

Mature Larva and Pupa of *Pyrrhopyge araxes arizonae* Godman and Salvin

The larva weaves a stout silken network between two leaves, and remains hidden during the daytime. The unique example was collected July 27, 1955.

Mature larva. Length, 40 mm. Greatest width, 8 mm.

Relatively stout, the dorsal segments tapering to a restricted neck, and the last two or three caudal segments becoming gradually narrower toward the cauda.

Head, wider than first segment; ground color black, but much obscured by a thick covering of long white hairs. On the area each side of the front these hairs become orange, which gives the appearance of a pair of orange spots.

Ocelli obscured by the hair covering, but probably black.

Antennae ringed black and orange.

The body is covered with white hairs, which are longer than those on the head, but more thinly scattered, and hence do not

[1] Biol. Cent. Amer. Rhop. 11. 253. 1893.
[2] Hesperioidea of America N. of Mexico. Univ. of Iowa Stud. in Nat. Hist. IX. (4); p. 16.
[3] Draudt in Seitz Macrolep. of the World. vol. 5. p. 837. 1924.

obscure the conspicuous bands of color. These bands encircle the body transversely, and are composed of wide red-brown elements alternating with narrow bright yellow stripes.

The scutellum is narrow, with a black transverse stripe on a yellow ground. Spiracles, light yellow.

Legs, red-brown proximally, shading to dull yellow, and terminating in a black segment. Prolegs, yellow, with light brown crochets. Suranal plate, smoky yellow.

The larva changed to a pupa July 29, 1955.

PUPA. Length, 27 mm. Greatest width, 10 mm.

Head, relatively narrow, brownish red, and clothed with numerous white hairs, except for a small group near the crown of the head, which are orange. Eyes, prominent, glistening, and covered with white hair.

Wing cases, brownish red, shading to almost black at margins, and free of hairy covering. Maxillæ extending .75 mm. caudal to wing margin. Abdominal segments, maroon margined on each segment, dull orange transversely on the centers of each segment, with a clothing of white hairs on the dull orange portions.

The thorax is relatively short, being less than one-quarter the length of the body. Cremaster, dark brown, strongly recurved ventrally, and bearing numerous small orange hooklets.

Spiracles, burnt orange. A number of small, flat, oval discs occur on the surface in close relationship to the spiracles.

The above description applies more particularly to the chrysalis immediately after the larval skin has been shed, and for a day or two thereafter. The more conspicuous colors then begin to disappear, owing to the formation of a white flaky powder, which obscures all of the surface except the head, spiracles and segmental junctures.

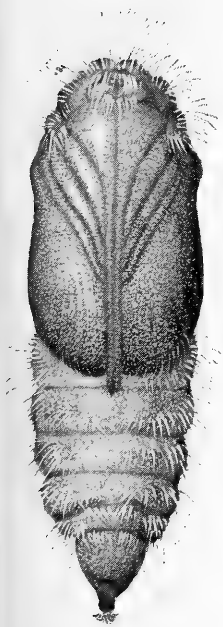

PLATE 38

Pupa of *Pyrrhopyge araxes arizonae* (G.&S.), ventral aspect, enlarged X3 — Drawing by the author.

The imago emerged from this pupa on August 18, 1955.

The pupa is illustrated on Plate 38.

The Life History of *Megisto rubricata cheneyorum* Chermock

Dr. Ralph L. Chermock, in 1948[4], gave the name *cheneyorum* to an Arizona subspecies of the Red Satyr, *Megisto rubricata* Edwards. The type locality for the holotype and allotype was Madera Canyon, Santa Rita Mountains, Pima County, Arizona. His type series included examples from Miller Canyon.

I obtained a gravid female of this subspecies in Miller Canyon, which, in captivity, on July 25-26, 1955 laid twelve eggs. Four examples were carried through to maturity, which made possible the following notes.

EGG. Subspherical, the base gently rounded and the side walls arching inward to the rounded top. Color, very light yellow or yellow-ivory. Width, 1.1 mm. Height, 1.5 mm.

The entire surface of the egg is covered with a reticulated network of hexagonal cells surrounded by low walls. These cells are rather uniform in size, even those of the micropylar area being quite similar in size and character to those on the side walls. There is some tendency toward arrangement of the cells in rows, running from base to top, but this does not create regular longitudinal ridges such as are characteristic of the eggs of *Euphydryas* or *Speyeria*.

In about three days the surface of the egg begins to show a mottled pink color. A day or two before hatching, the black head of the larva shows through the shell as a large round black spot.

The eggs hatched August 4-5, 1955, making ten days in the ovum.

The larva consumes the major portion of the egg shell.

FIRST INSTAR LARVA. Length, 4 mm. Body cylindrical, tapering gradually and uniformly to the cauda.

Head; much larger than first body segment; jet black. It is somewhat squared at the upper edge, and is topped by two knobs. A few very short black setae are scattered over the surface.

[4] Can. Ent. LXXX (1-12) pp 172-173.

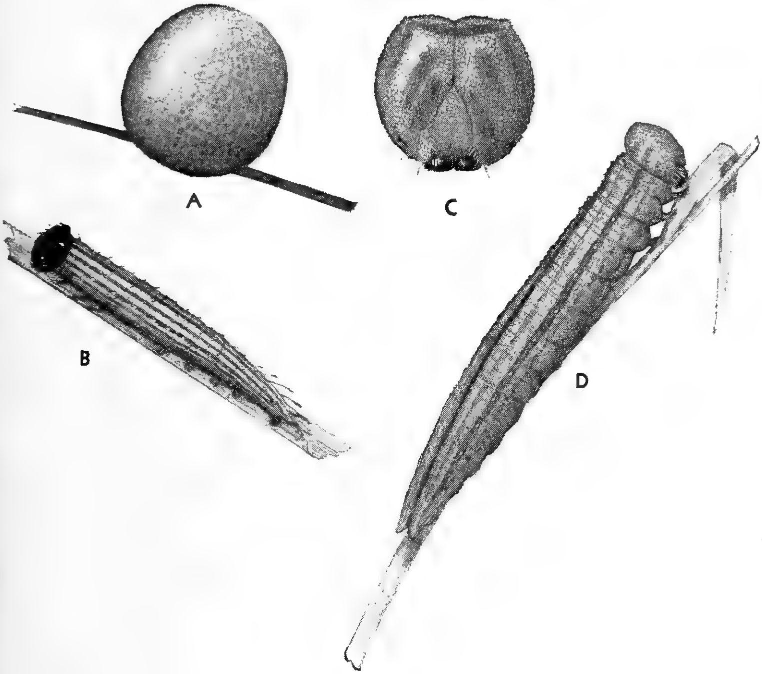

PLATE 39

Egg, and larva of *Megisto rubricata cheneyorum* Chermock.

A. Egg, enlarged X15. B. First instar larva, enlarged approximately X10. C. Head of mature larva, enlarged X7. D. Mature larva, enlarged approximately X2½. Reproduced from drawing by the author.

Body; ground color, straw. Longitudinal stripes extend the length of the body. One of these runs mid-dorsally. Three on each side parallel this. The first is placed dorso-laterally. The second is of equal width, and is placed in line with the spiracles. The third is slightly narrower, and the space between the stigmatal stripe is a little narrower than that between the stigmatal and the dorso-lateral stripe.

There is also a very narrow discontinuous line along the 'overlap'.

The cauda is prolonged into a pair of tapering processes, each of which is topped by a long seta, clubbed or expanded at the end. A number of setae of this character occur on the three caudal segments, all of which arch or point caudally. Very minute clubbed setae are present on the other body segments.

The legs and prolegs are concolorous with the body.

The first instar larva is illustrated on Plate 39, fig. B.

Ecdysis occurred on August 19-20, 1955.

Second instar. Length, 6 mm.

Head; width, 1.2 mm. Wider than first segment, and completely encrusted with light gray papillæ, each of which bears a minute hair. Knobs, or 'horns' on upper corners more prominent than in the first instar, and covered by the same type of papillae and hairs. Front, black, as are also the ocelli.

Body; cylindrical, of equal width from first to fifth segments, then tapering gradually to cauda.

The entire body is encrusted with small cream colored papillae, each topped by a minute hair. These are so thickly placed that they somewhat obscure the dull pink ground color. There is a mid-dorsal longitudinal stripe of dull rose, which becomes darker near the cauda, and which is edged with narrow lines of cream-yellow. A similar bordered line parallels this dorso-laterally, and a third suprastigmatally.

The stigmatal line is narrower, and below this, on the overlap, is a wide yellow line.

The caudal paired processes are proportionately longer than in the first instar.

The abdomen is dull pink, legs translucent; prolegs and anal prolegs concolorous with the body.

Ecdysis occurred on August 23 to 26, 1955.

Third instar. Length, 8.8 mm. Head width, 1.6 mm.

The head is now encrusted with the same type of papillae as occurs on the body, and is of the same color, — a very light tan. The pair of horns are darker than the ground color, and there is an indistinct dark bar running transversely across the crown from the base of each horn to its fellow of the opposite side.

The sutural lines separating the lobes and front show clearly as sharp black lines, and the face begins to show a shadowy pattern of dark lines beneath the encrusting papillae.

Ocelli, black. Mouth parts edged with black. Antennae tinged with yellow.

The body has very much the same character and color as that described for the second instar, except that the dull rose color has been considerably toned down, giving the lines a different shade of tan, accented by stripes of minute black dots.

In succeeding instars the principal changes consist of a relative reduction of the cephalic horns, a lightening of the color to various shades of soft tan, with fainter definition of the longitudinal lines, with more noticeable encrustation of the surface, probably due to the increase in size of the multitudinous papillae that completely cover the head and body. The caudal segments become somewhat foreshortened and progressively narrowed. The ratio of growth, and schedule of ecdysis shows marked disparity between individuals.

Mature larve. Length, 25 mm. Greatest width through fifth segment, 4 mm. Head width, 3 mm. Head height, 3 mm.

The cephalic 'horns' have been reduced to low nodules.

The ground color of the head is light tan with a mottling of dark brown, which, in some individuals, tends to form three diagonal bands on each cheek, and a transverse band running across the crest. The raised nodules are somewhat larger than those covering the body, but are of the same character.

Only two occelli are visible on each cheek, one being relatively large, and the other, superior to it, very small. These are set in a depression. The remaining ocelli may be present, but they are completely obscured by the raised nodules.

The mouth parts are dark brown, and the mandibles black.

A number of moderately long hairs surround the mouth parts.

Body; ground color light tan in most individuals, but a few are very much darker. The longitudinal bands are more clearly defined than in the preceding one or two instars. The mid-dorsal stripe is narrow, and very dark. The next lateral band is light, and has a faint margining of soiled white. The suprastigmatal band is wider than the others, and is clearly defined. It bears small white dots, one to a segment. There is a wide dark longitudinal line just below the overlap. A few individuals also show a faint narrow substigmatal line, broken at each segment.

The abdomen is light tan; spiracles, black; legs and prolegs, concolorous with body, the crochets, dark tan.

The larvae are exceedingly lethargic throughout their entire development. By the end of August, 1955, they ceased to feed except spasmodically, and were apparently hibernating from then on until they began preparing for pupation in April, 1956.

Only seven individuals survived to the prepupal stage. This may have been in part due to the fact that the various grasses offered them were not as much to their liking as the native species on which they normally feed.

Shortly before pupation the larvae spin a fragile pad of silk, and assume a curved posture. In captivity, they pupate in the debris on the floor of the breeding cage, or at the bases of dried grass stalks.

The first example pupated on April 29, and the last on May 31, 1956. Of the seven pupae, only four gave forth imagos. The first hatched on May 26, and the last on June 22, 1956. The period in pupa was 27, 23, 31 and 30 days, or an average of approximately 28 days.

The mature larva is illustrated on Plate 39, fig. D, and an enlarged figure of the head of a mature larva is shown on the same plate, fig. C.

Pupa. Length, 10.5 mm. Greatest width 4.3 mm.

The form is a robust ovoid, with the cephalic end well rounded, and the cremaster extending ventrally at right angle to the body. The ground color is light straw, shading to a blackish brown on the ventral surface of the last six abdominal segments.

The wing cases show a delicate penciling of brown along the neurations which expand at the wing margin to form triangulate dark points. The margin next to the thorax bears a brownish black edging, accented by an accompanying white stripe immediately ventrad to it.

Over the crest of the thorax there is a narrow longitudinal low ridge. In the mid-dorsal line there is a faint longitudinal band which fades out as it nears the thorax. Lateral to this on each side there occurs a row of round brown dots, two to each segment.

Along the side of the abdomen are a number of brown dots, four or five to each segment, more or less regularly spaced.

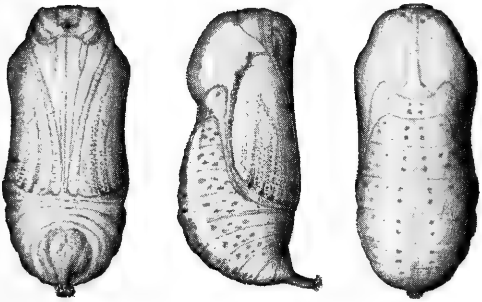

PLATE 40

Pupa of *Megisto rubricata cheneyorum* Chermock.

A. Ventral aspect. B. Lateral aspect. C. Dorsal aspect. All figures enlarged approximately X3½. Drawing by the author.

The eye is prominent, but does not bulge noticeably. Both the antennae and maxillae extend to the wing margins.

The spiracles are small inconspicuous ovals, margined with narrow brown circlets. The cremaster is slightly arched, extending ventrally, tapering, and terminating in a rosette of numerous yellow spicules with minute recurved tips. The pupa is illustrated on Plate 40, figs. A, B, C.

The parent species, *Megisto rubricata* Edwards was described in 1871[5], the type being "taken near Waco, Texas! Chermock states that the genitalia of his subspecies are "identical to those of the typical subspecies."

In view of the close relationship, it is more than likely that the metamorphosis of the Texas species will closely approximate that of the Arizona subspecies.

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[5] Trans. Am. Ent. Soc. Vol. 3, p. 212.

SCIENTIFIC NOTES

SYLVATIC *TRYPANOSOMA CRUZI* IN *TRIATOMA* FROM SOUTHERN UTAH

Ten nymphs of *Triatoma protracta* Uhler were collected on 27-VIII-54 from three wood rat dens at the base of roadside junipers along U. S. Highway 89, 6.3 miles south of Mt. Carmel Junction, Kane County, Utah. These bugs were successfully transported to Los Angeles through northern Arizona and southern California deserts by use of a water cooler (Wood & Wood, 1952, Bull. So. Calif. Acad. Sci. *51*:108-111) without loss of uninjured specimens.

Examination microscopically of the feces of 1 dead 3rd instar nymph on 3-IX-54 was negative for trypanosomes. This bug was crushed by falling twigs when collected. Subsequent examination of three 5th, three 3rd, and one 2nd instar nymph revealed one 5th and one 3rd naturally infected with a trypanosome indistinguishable morphologically from *Trypanosoma cruzi* Chagas.

Wood and Wood (1938, Am. Jour. Trop. Med., *18*:207-212) reported collections of *Triatoma protracta* from 13 wood rat dens in southern Utah. Twenty specimens were obtained 7 mi. north of Kanab, Kane County, on U. S. 89 on 5-VIII-36 and 38 bugs were taken 10-16 mi. west of St. George, Washington County, on U. S. 91 on 7-VIII-36. Of the 58 bugs collected, 51 were examined and all were negative for trypanosomes although the Kanab specimens are very close to the locality reported above. Thus, the 1936 sample averaged 4.5 bugs per den for the 13 wood rat dens examined. The 1954 sample averaged 3.3 bugs. This is the first report of *Triatoma protracta* naturally infected with *Trypanosoma cruzi* from Utah.

Wood and Wood (1941, Am. Jour. Trop. Med. *21*:335-345) specified 38° Latitude North as the most northerly extension of animals infected with *Trypanosoma cruzi* Chagas in the United States. However, Davis (1943, U. S. Publ. Health Repts., Washington, *58*:1006-1010) reported Plymouth, Amador County, California as a source of naturally infected *Triatoma protracta* and this remains the most northerly locality known to date at 38°, 30′ since the Mt. Carmel location is 37° North,—Sherwin F. Wood, Life Sciences Department, Los Angeles City College, Los Angeles 29, Calif.

BRIEF NOTES ON THE LIFE HISTORIES OF THREE ARIZONA MOTHS

Prochoerodes forficaria Gn.

During June of 1956, while collecting life history material at the Tonto Creek Camp grounds, near Kohl's Ranch, Gila County, Arizona, a single larva was beaten from black walnut on June 30. This was reared to maturity, and turned out to be the geometrid moth, *Prochoerodes forficaria* Gn.

In view of the fact that nothing is known concerning the metamorphosis of this species, the following brief notes are worthy of record.

Larva. Penultimate instar. Length, 24 mm. Cylindrical. Ground color, gray.

Head; smaller than first segment; flattened; color, gray with heavy black mottling concentrated across the center of the face. Ocelli, black. Mouth parts edged with black. Antennae, ivory, shading to yellow on the terminal segments.

Body; gray, heavily sprinkled with brown and black dots, and streaked with discontinuous sinuate lines.

In the mid-dorsal area there is a concentration of the dark markings to form a semblance of a tripled longitudinal band, intensified at each typical segmental juncture by a mark resembling a capital X, the crossing of the latter placed on the segmental line. These marks are most prominent on the 4th to 9th segments.

Stigmatally there is a longitudinal band, composed of elongate triangles, the wide portion of each being centered on the segmental juncture, and the tips of the triangles being joined immediately inferior to the spiracles. The latter are small, round, and inconspicuous, with yellow centers and black circlets.

The abdomen is a uniform gray, mottled with dark dots and sinuous dashes.

Legs, prolegs (a single pair), and anal prolegs concolorous with the body.

The 10th segment is protruded dorsally, and topped by a pair of papilliform tubercles. These rest on a whitish base.

The setae are short and colorless. Those on the dorsum rise from black tubercles for the most part, but on the lateral surface the setal-bearing tubercles are predominantly gray.

Mature larva, observed July 15, 1956; Length 33 mm.

The dorsal X marks tend to form a series of triangles, with lighter colored centers. Otherwise the larva is marked much as in the preceding instar.

Pupation occurred on July 22, 1956.

Pupa. Length, 16mm. Color, wood-brown, with fine black dashes, and transverse sinuate lines over the wing cases and thoracic appendages, and black mottling on the abdominal segments.

The maxillae extend 1 mm. beyond the wing margins, while the antennae reach only .5 mm. beyond the same margins.

The cremaster is formed of a pyramidal body from which a single long stout spine or shaft points caudally. This is topped with a recurved tip. The spine bears, near its base, numerous short spicules, which point laterally.

The imago emerged August 6, 1956.

Halisidota lurida otho (Barnes)

In the Canadian Entomologist for February, 1901, page 53, Dr. William Barnes described "*Euhalisidota otho*", naming it for Otho C. Poling, who took the types in the Huachuca Mountains, Arizona.

The moth is now listed as a subspecies of *Halisidota lurida* Henry Edwards. It is very likely that Poling first secured the species in the region near the mining town of Palmerlee, in Miller Canyon.

While collecting in this area in 1955 I captured a gravid female of *otho* on July 24, from which I obtained 43 eggs.

These were deposited in regular rows on the cover of a rearing jar, the dates of laying being July 24 and 25, 1955.

The egg is a perfect hemisphere, 1.25 mm. in width, and .75 mm. high. Its surface is smooth and glistening, with no apparent reticulations or rugosities. The base is flat, and no visible micropyle is present. It is bright lemon-yellow in color.

The eggs hatched August 4 and 5, making a period in ovum of ten days.

The young larvae were offered grass, on which they fed through three instars.

First instar larva. Length, 3.5 mm. The head is a bright glistening yellow, larger than the body segments.

The body is cylindrical, and dull yellow in color, in strong contrast to the head. It bears numerous black papillae, arranged in longitudinal rows, each papillus being topped by a long black hair.

Ecdysis occurred August 10, 1955.

Second instar. Length, 4.75 mm. The head is yellow-orange, and the ocelli, black. The body ground color is dull olive-green in the dorsal area from the first to ninth segments, the remainder of body including abdomen being dull yellow. Numerous black papillæ occur on the body, arranged in more or less regular longtitudinal rows. Each gives rise to a tuft of long black hairs, those on the first two thoracic and last two caudal segments being the longest.

A few very long white hairs occur on the first two segments.

The legs and prolegs are colorless and translucent. The anal pair is dull orange.

Ecdysis, August 15, 1955.

Third instar. Length, 7 mm. The head is a glistening yellow-orange, and the ocelli brownish black. The adfrontal sutures are black. The antennae are white, the clypeus, dull ivory, and the mandibles, black.

The body ground color is dull olive above the stigmatal area, and dull yellow below, including the abdomen.

The dull olive area bears several longitudinal rows of prominent black papillae, each bearing a tuft of black bristles with an occasional white hair. The first and second segments carry numerous long white hairs, mixed with some shorter black hairs, all of which arch forward over the head. A few long black hairs also occur on the last caudal segment.

On the infrastigmatal area there are two longitudinal rows of black papillae (dull yellow at their bases), each of which carries a small tuft of short white hairs.

The legs, prolegs, and anal prolegs are dull yellow.

The larvae went into hibernation at the end of the third instar, and did not survive the winter.

Halisidota mixta (Neumoegen)

Another member of the Genus *Halisidota* occurring in southern Arizona, concerning which nothing is known of its early stages, is *Halisidota mixta* Neumoegen. The moth was described in Papilio, Vol. 2, p. 133, 1882, the type locality being "Southeastern Arizona."

Mature larvae were taken in Madera Canyon, Santa Rita Mountains, July 27, 1955, feeding on oak.

Mature larva; head, jet black; clypeus edged with dull white; base of antennae, white, the remaining segments black.

Body color, mottled gray-green and black, heavily obscured with tufts of yellow and black hairs.

There is a mid-dorsal row of short black hairs, lateral to which are tufts of short yellow hairs. Below these occurs a series of black nodules bearing mixed black and white or black and yellow hairs.

On the first two segments there are many long mixed yellow and black hairs arching forward over the head.

On the fourth segment there is a pair of long black straight hair pencils pointing dorso-laterally, and a similar pair occurs on the ninth segment.

Legs, black; prolegs and anal prolegs, burnt orange.

Notes were not made of the pupa. Two moths emerged August 12, 1955.

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VOLUME 56 - - - - - PART 1, 1957

HEAD MUSCLES OF SALAMANDERS

by WILLIAM A. HILTON,
Department of Zoology, Pomona College

The adults of eight and the larvae of six families were studied and in these the majority of the world's genera were involved in the observations of the muscles.

It was found that there was a greater uniformity in the structures than the terminology employed in the past. As far as possible the classification of Francis '34, is followed with a more critical study of the nervous system and nerve distribution left for another time.

The muscles of the head and particularly of the throat have been the subjects of numerous, sometimes conflicting accounts. No other part of the body has been more difficult to understand and describe.

Many early observations before 1850 give information about the head muscles, such as Funk 1827, Carus 1828, Dugès 1834. Rusconi in 1854, was about the first to discuss the changes of muscles during metamorphosis. Later works are those of Wilder, 1892-6, Goppert, 1894-8 and Drüner, 1901-4. Other very valuable contributions were by Luther, 1914, Edgeworth, 1920, Smith, 1920, and more recently those of Eaton, '33-36, Francis '34 and Piatt '35-40, as well as a number of other writings dealing with special topics connected with amphibian muscles.

M. LEVATOR MANDIBULAE ANTERIOR, Edgeworth '20, Francis '34, Eaton '36; temporalis, Funk 1827, Cuvier 1835, Fischer 1843, Lubosch 1914; pterygoidien, Rusconi 1854; pseudo-temporalis, Luther 1914. This is a triangular muscle from the frontal and perhaps parietal bones, inserted on the lower jaw. It is supplied by branches of the fifth cranial nerve. It helps to close the mouth.

M. LEVATOR POSTERIOR, Edgeworth '20, Francis '34, Eaton '36; cranio-mandibularis (part), Lubosch 1914; aductor mandibulae posterior, Luther 1914. It is from the frontal and the parietal bones to be inserted in the lower jaw back of the eye. It is supplied by a branch of the 5th cranial nerve. It aids in closing the mouth.

M. LEVATOR MANDIBULAE PROFUNDUS, Eaton '36; M; levator mandibulae (deep portion) Edgeworth '20; frontales, Funk 1827;

pterygoideus, Cuvier 1835, Fischer 1843, Owen 1866, Drüner 1901, Lubosch 1914, Luther 1914; pterygoidien, Rusconi 1854; ptergo-maxillaris, Hoffman 1873-4. This muscle under the superficial muscles mentioned above in many cases seems a part of them. It is variable in position and distribution among salamanders. It is supplied by branches of the fifth cranial nerve. It aids in closing the mouth.

Pterygoideus, Eaton '36, Lubosch '14 and others. This small muscle covered with the larger more superficial ones is from the pterygoid region of the skull to the lower jaw. It is supplied by the fifth cranial nerve. It helps close the mouth.

All these levator muscles just mentioned are really part of one system and distinctions between them are not always sharp. They vary in different forms.

M.levator mandibulae externus, Edgeworth, '20, Francis '34, Eaton '36; masseter, Funk 1827, v. Siebold 1828, Fischer 1843, Rusconi 1854, Schmidt, Goddard, van de Hoeven 1864, Owen 1899, Mivart 1869, v. Pessen and Rabinowicz 1891, Drüner 1901, Coghill 1901-6, Osawa 1902; temporal, Cuvier 1835; pre-tympano-maxillaris, Hoffman 1873-8; mandibularis externus, Lubosch 1914; aductor mandibulae externus, Luther 1914. This has its origin from the anterio-lateral edge of the squamosal and the anterior wall of the otic capsule. It is inserted on the posterior end of the dentary and lateral face of the coronoid process of the pre-articular region and in some cases to the skin of the corner of the mouth. It is served by the fifth cranial nerve. It aids in closing the mouth.

M. depressor mandibulae, Edgeworth '20, Francis '34; depressor maxillae inferioris, v. Seibold 1828; temporo-angulare, Duges 1834; digastricus, Fischer 1843; Stannius 1854-6, Osawa 1902; digastrique, Cuvier 1855, Rusconi 1854; occipito-mandibularis s. digastricus mandibulae, Owen 1866, digastris, Mivart 1869; digastric et depressor mandibulae, Humphrey 1872; cephalo-dorso-maxillaris s. digastricus maxillae, Hoffman 1873-8; c2md, Ruge 1897; cephalo-dorso-mandibularis, Drüner 1901.

This is a large muscle arising from the posterior edge of the squamosal and ear capsule and anterior portion of the fascia cephalo-dorsalis of Drüner and inserted on the end of the lower jaw below. It is supplied by a branch of the 7th nerve. It opens the mouth.

It is interesting to note that in many cases the closing muscles of the jaw are larger in total bulk than the opening ones.

In some larvae and adults, a division of the depressor mandibulae runs back to the ceratobranchial and is sometimes called ceratomandibularis. Such a division is found in Proteus, Necturus, Typhlomolge, Amphiuma. In Siren this is attached to the tip of

the ceratohyal. This connection to the ceratohyal I found in the larvae of Ambystoma, Dicamptodon and Rhyocotriton. It may occur in others, but I have not noticed it.

THROAT MUSCLES
SUPERFICIAL LAYER

M. INTERMANDIBULARIS, Edgeworth '20, Francis '34; mylohyoideus, v. Siebold, Carus 1828, Stannius 1854, Owen 1866, Coghill 1901-6; mylohyoideus et interhyoideus, Ealter 1887; mylohyoideus et interhyoideus posterior, Funk 1827.

This is a sheet of muscle across the floor of the mouth just under the skin. In the larva it consists of a small anterior, M. intermandibularis anterior as the M. i. posterior. Kesteven '41, prefers the name submentalis for the anterior portion, which seems better.

M. INTERMANDIBULARIS POSTERIOR, Drüner 1901, Luther 1914, Edgeworth 1920, Francis '34 and others. It arises from the inner or mesal edge of each side of the mandible in its middle portion. The fibers extend towards the middle line from each side to join a broad or narrower aponeurosis in the center. It is supplied by the N. mandibularis of the fifth cranial nerve.

It elevates the throat in breathing.

M.INTERHYOIDEUS, Edgeworth 1920, Francis '34, Piatt '35; M. constrictor pharyngis internus, v. Siebold 1828; mylohyoidien (middle part) Rusconi 1854; C2hv, Ruge '97; inter-os-quadrata, Drüner '01.

In adult Hynobiidae and Salamandridae this has been described as two muscles. Piatt '40, suggests that the more anterior should be known as the sub-hyoideus and the posterior the inter-os-quadrate, but in other families it may be called interhyoideus. So far as I have seen there are not two muscles in all Hynobiidae or Salamandridae and there may be two in other groups. Also the use of the name sub-hyoideus would merely add to the already great confusion as a well defined muscle in another place has been given this name.

This interhyoideus arises from the postero-mesal edge of the quadrate to spread out broadly over the caudal part of the mouth floor. Sometimes by means of fibers or a rather separate division it may reach quite cephalad under the fibers of the M. intermandibularis posterior. It is supplied by branches of the R. jugularis of the 7th cranial nerve.

It constricts the hyobranchial skeleton and the back part of the mouth, assisting in respiration and swallowing.

M. INTERHYOIDEUS POSTERIOR, Edgeworth '20, Francis '34; constrictor pharyngis externus, v. Siebold '28; myo-hyoideus (posterior part) Rusconi 1854; mylosternoideus, Walter 1887; C2vd, Ruge '97; quadrato-pectoralism Drüner 1901.

In the Plethodontidae in the adult two muscles may arise from this, or at least occupy this region; the quadrato-pectoralis whose origin may run over or near the angle of the jaw and a muscle said to be distinctive of this family, the gularis as recognized by Smith '20. The name interhyoideus inferior may be considered the right one in all groups but Plethodontidae and here it may be said to have a quadrato-pectoralis portion which is nearer the angle of the jaw and the gularis which takes origin farther back from fascia on the side of the neck. The insertion is into the connective tissue region of the gular fold. It is supplied by the gular branch of the 7th cranial nerve.

The function is to constrict the pharynx, aid in respiration or depress or tip the head to one side or the other.

M. genio-glossus, v. Siebold 1828, Fischer 1843, Mivart 1869, Drüner 1901, Francis '34 and others.

This muscle at the mandibular symphsis takes origin from this area and is inserted into the tongue. It may have median and lateral portions. It may show from the surface before the other muscles are removed or be represented by a few deep fibers or be entirely lacking. Free tongued forms do not have it as in some of the Plethodontidae, while others in this group may have it poorly developed. In some families it is found in some species but not in others. It is supplied by branches of the spinal nerve which is sometimes called the hypoglossus.

If the tongue is at rest, the muscle may draw it to the front of the mouth and arch its surface, but if the tongue is fully extended the contraction of the muscle tends to retract it into the mouth. When the tongue is drawn towards the front of the mouth the muscle may press out a sticky mucous from the tongue for the purpose of capturing insects or other live food.

DEEP MUSCLES

M. genio-glossus sometimes seen near the surface is frequently either absent or deeply buried under other muscles.

M. genio-hyoideus, Carus 1828, Fischer 1843, Mivart 1869, Osawa 1902, Francis '34; rectus linguialis, Funk 1827; levator maxillae inferioris s. geniothyroideus, von Siebold 1828, Stannius 1854-6; levator maxillae inferioris longus, Schmidt, Goddard, van de Hoven 1864; genio-branchial, Humphrey 1872; maxillo-hyoideus, Hoffman 1873-4; genio-hyoideus s. rectus superficialis hypobranchialis anterior, Drüner 1901.

This is a pair of strong longitudinal muscles arising from the inner edge of the lower jaw either side of the middle line and inserted for the most part into the os triangulare and to some extent to the tissue near or in the central region when there is no os triangulare. The hypoglossal nerve supplies fine branches to these muscles.

The action of these muscles is to depress the jaw, or whole head or pull forward the os triangulare and the heart region.

M. GENIO-HYOIDEUS TERTITUS, was described by Drüner in 1901 as an abnormality, where a few lateral fibers pass from the jaw to the posterior end of the ceratohyal. A similar condition has been described where fibers pass from the posterior cornu of the hyoid to the anterior part of the lower jaw, according to Francis '34. He suggests also that this may represent the M. genio-hyoideus lateralis described by Smith '20, in Eurecea.

The muscles under the name of M. genio-hyoideus tertius have the same nerve supply and same general function as M. genio-hyoideus.

In a number of cases fibers run from the mandible not far from the middle line, under the M. genio-hyoideus and end at or near the upper end of the ceratohyal. This may or may not be the muscle given the name M. genio-hyoideus tertius. To me it seems a slip from M. genio-hyoideus of Smith.

M. SUBHYOIDEUS, Drüner, '04, Francis '34; ceratoglossi externi, Funk '27; os hyoides protrahens, Carus 1828; geiohyoideus lateralis, Drüner 1901; genio-hyoideus lateralis, of Smith.

Lateral to the genio-hyoideus on each side is this variable muscle about which there is some confusion with the subhyoideus or genio-hyoideus lateralis.

Although a muscle in this position, lateral to the M. genio-hyoideus is found in salamanders generally; its form and connections are variable and different perhaps also as to homology and origin and should perhaps have the name applied to it depend upon the group to which the animal possessing it belongs.

In general it arises from the posterior end of the cerato-hyal which it may partly enclose and run slightly diagonally forward to be inserted on the dorsal side of the aponeurosis of the M. intermandibularis. Drüner '01, describes a slip from this muscle to the lower jaw; in another of the Hynobiidae, Salamandrella, I found fibers running in that direction but not connecting with the jaw. In Hynobiidae and Salamandridae this muscle is supplied by the jugular branch of the 7th cranial nerve. It seems to be derived from the interhyoideus of the larva as its nerve supply might indicate. Smith '20, in a plethodont Eurecea describes the development of a muscle here called M. genio-hyoideus lateralis, derived not from the interhyoideus, but from the M. genio-hyoideus, whose nerve supply is not from the 7th cranial, but from the first spinal. Piatt '40, has investigated the nerves of this muscle in a number of the plethodontidae and finds the first spinal nerve is concerned in every case. According to Piatt then, the muscle in Salamandridae and Hynobiidae should be called subhyoideus and the term genio-hyoideus lateralis should be restricted to Plethodontidae.

The genio-glossus lateralis of Ambystomidae is said by Piatt to be homologous with the genio-hyoideus lateralis of Plethodontidae, but its relations are different, so the name genio-hyoideus lateralis need not be used.

M. subarcualis rectus, Edgeworth '20; cerato-glossi-interni, Funk 1827; ceratoglossus, v. Siebold 1828; pre-stylo-peribranchial, Dugès 1834; cerato-hyoideus-internus, Fischer 1843, Mivart 1869, Hoffman 1873-8, Walter 1887, Drüner 1901; protacteur de la corne hyoidienne posterieure, Rusconi 1854; cerato-hyoideus, Stannius; cerato-hyoideus externus, Osawa 1902.

This arises from the posterior end of the first cerato-branchial cartilage, enclosing it in a muscular sheath. The fibers are inserted into the ventro-anterior border of the anterior end of the cerato-hyal, in this way connecting extreme ends of the two cartilages. It is supplied by branches of the 9th and 10th cranial nerves.

Its contraction advances the branchial arches and associated parts connected with the copula in the extrusion of the tongue. It is a characteristic muscle in adults that have passed the larval period and is quite similar in appearance and position in Hynobiidae, Salamandridae, Ambystomidae and Plethodontidae.

M. sterno-hyoideus, Smith '20; rectus v. Siebold 1828; sterno-hyoideus superficialis, Furbinger 1873; rectus superficialis hypobranchialis s. sterno-hyoideus, Drüner 1901; with rectus abdominis superficialis or abdominus musculus rectus, Carus 1828; rectus cervicus superficialis, Edgeworth '20. A thin layer of muscle arises from the sternum and fascia near. This passes forward dorsally to the coracoids and ventral to the pericardium as a broad sheet with several insertions such as the following: at the junction of hypobranchial 1 and copula; on the tendon of the profondus portion of the muscle; more ventrally and mesially to the triangulare. Part of it is attached to the pericardium and sometimes fibers go on beyond the os triangulare to be inserted into the hypobranchial skeleton ventro-medially.

It is supplied by branches of the first three spinal nerves.

Its central fibers support the M. genio-hyoideus and its lateral fibers assist the abdomino-hyoideus in retracting the tongue.

M. abdomino-hyoideus, Smtih '20, Piatt '40; rectus cervicus profundus, Edgeworth '20, Francis '37; hebosteoglossus, v. Siebold 1828; sterno-hyoideus profundus, Furbinger 1873; rectus hypobranchus profundus s. abdomino-hyoideus, Drurer '01; with rectus abdominus profundus, M. epischio-hyoideus, Carus 1828; rectus cervicus profundus, Edgeworth '20, Francis '34.

This muscle forms the direct forward continuation of the M. rectus abdominus profundus. It passes forward about the lateral parts of the pericardium, mesial to the thyroid gland and between the hypobranchial cartilages 1 and 2, to be inserted on the dorsal side of the copula by a tendon. It may have an outer rather distinct slip which may be partly inserted into the first and second ceratobranchials as it passes between them. It is supplied by branches from the upper spinal nerves, or from the first, second and third.

It may retract the tongue or depress the head.

It is convenient to discuss some variations in the last two muscles at this time.

In *Salamandrella* of Hynobiidae, the sterno-hyoideus for the most part ends cephalad of the heart towards the middle line about the level of the os triangulare with a slip forward to the hyobranchial region. The abdomino-hyoid sends a mediam slip to the region of the os triangulare and another to the median portion of the hyobranchial apparatus while much of its substance passes between the first and second epibranchial to end on the dorsal side of the copula. In *Ambystoma maculata,* the broad sterno-abdominalis ends for the most part in the middle line on the os triangulare. The abdomino-hyoid sends a small slip to the os triangulare with little indication of terminations in the middle line until it terminates on the dorsal side of the copula. In *Rhyacotriton,* the abdomino-hyoid sends a small slip to the caudal surface of the os triangulare and several slender strands to the ventral side of the basibranchial and hyoid apparatus, but as in many others, most of its fibers end dorsally on the copula. In *Salamandra,* most of the abdomino-hyoid fibers end dorsally on the copula, but a few cross over to end ventrally and a few terminate on the os triangulare. The sterno-abdominalis broadens out to end largely in the region of the pericardium. In *Diemictylus viridescens,* sterno-hyoid fibers end in large numbers towards the middle line on the hyobranchial apparatus. The abdomino-hyoid with little indication of fibers on the os triangulare has a conspicuous small bundle which comes from underneath to end in the middle line of the copula. In *Cynops pyrogaster* the condition is much the same. In *Taricha torosa* there is a lateral slip to the os triangulare but none to the central ventral surface of the basibranchial. In *Plethodon glutinosus,* as the two muscles pass to the os triangulare, a lateral slip is sent to the latter and a small one to the median dorsal surface of the copula. The central part of the sterno-hyoid is broad. *Aneides* and *Pseudotriton* are similar with the median part of the sterno-hyoid broad from side to side.

M. ceratohyoideus externus, Piatt '40, Easton '37.

This is often a large muscle from the ventral and basal end of the ceratobranchial. It is supplied by branches of the 9th and 10th cranial nerves. It moves the ceratobranchials and the ceratohyals. It is found in some gilled adults and in the larval forms of all groups. It is lost in adults without gills.

The other muscle often considered with it, is the subarcualis rectus 1, also found in gilled adults, larvae and adults without gills is often more prominent in the adult, where it replaces the M. ceratohyoideus externus. It is convenient to call this M. ceratohyoideus internus in comparison with the externus.

M. pectori-scapularis, Edgeworth 1920, Francis 1937; omohyoideus, Meckel 1869, Humphry 1872, Hoffman 1873-4, Osawa 1902; scapulo-post-hyoiden, Dugès 1834; pectori-scapularis internis, Furbinger 1873; pectori-scapularis s. omohyoideus, Walter 1877, Drürer 1901.

This is a small muscle which arises from the mesial surface of the ventral end of the scapula and is inserted at the lateral edge of the superficial part of the sterno-abdominalis. It serves to strengthen or brace the sterno-abdominalis.

M. hyoglossus, Fischer 1843, Drüner '01, Smith '20, Francis '37, Piatt '40. This small muscle has fibers from the dorsal side of the forward end of the copula into the tongue substance. It is supplied by branches of the first spinal nerve. It may compress the tongue, or change its shape slightly.

M. suprapendicularis, Smith '20, Piatt '40.

It arises from the medial border of the ceratohyal on each side. It is probably supplied by the first spinal nerve. It helps to force the tongue forward on contraction. It has been described especially in free-tongued forms among the Plethodontidae but is also found in some others.

MUSCLES ASSOCIATED WITH THE GILLS

M. ceratohyoideus externus and internus, already mentioned.

Subarcualis recti muscles, Edgeworth, 1920, Eaton '36, Piatt '40. These are usually two in number, the longest connects the first and last branchial arches and the second usually joins the last two arches. They are probably supplied by branches of the 9th and 10th cranial nerves. By their contraction the gill arches are brought together.

M. subarcualis obliqui, Edgeworth, 1920, Eaton '36, Piatt '40. These usually run from their origin on median muscles to be attached to the second or third arches or the last two arches. Probably supplied by the 9th and 10th cranial nerves. They help pull the arches forward.

M. protractor arcus ultimi, Hoffman 1878, Wilder 1891. In Siren and Proteus, from the base of the last ceratobranchial to the posterior side of the hypobranchial.

M. LEVATORES ARCUUM, Fischer 1864; levatorarcus branchialis 1-4, Emerson '05, Eaton '36. These muscles vary in different larvae and adults in number and position. L.A.1 may arise from the posterior side of the squamosal and others up to 4 or 5 may form a fan-shaped group of muscles and fascia on the side of the body to be inserted at the base of the gill region. Probably supplied by branches of the 10th cranial nerve. They may pull the whole gill region closer to the head.

M. OMO-ARCUALIS, Piatt '36; prococoraco-branchialis, Wilder '91. This arises from the anterior angle between scapula and procoracoid and runs forward to be inserted on the last gill arch near the gill. It has been found in Proteidae, Sirenidae and the larvae of Hynobiidae. I have found it in Proteus, Necturus, Siren and Pseudobranchus adults.

GILL MUSCLES (following Piatt '38)

There are two sets of delicate intrinsic gill muscles. The dorsal are the levatores branchiarum and the ventral the depressor branchiarum.

MUSCLE CHANGES FROM GILLED LARVAE TO ADULTS THAT LACK GILLS

The intermandibularis anterior, or as Kesteven prefers it, the submentalis in some salamanders disappears in the adult, especially in the Hynobiidae, Salamandridae, Ambystomidae and Plethodontidae.

In the larva the large ceratohyoideus is lost when the adult stage is reached and in many cases the smaller internus becomes larger in many cases.

The thoracico-hyoideus of the larva transforms into the abdomino-hyoideus and the sterno-hyoideus of the adult. In the larva the muscle has a proliferation and an anterior growth of fibers which brings the origin on the dorsal surface of the first basibranchial to make the beginning of the abdomino-hyoideus. There is also a breaking down of the median portion of the thoracico-hyoideus and a differentiation of the ventral slip of the larval muscle into the sterno-hyoideus. (partly after Smith '20).

In some Plethodontidae there may be proliferation of the anterior end of the genio-hyoideus laterally, but this does not always last after transformation.

The subarcualis rectus muscles disappear in the adult when the gill arches are lost. Possibly some may be transformed into pharyngeal muscles.

The subarcualis obliqui of the larvae disappear in land stages. The levator archum muscles disappear as such in the adult to become dorsal pharyngeal muscles or contribute to them.

In several families, the so-called interhyoideus posterior or quadrato-pectoralis becomes two muscles, Piatt '40, considers those in Hynobiidae and Salamandridae to be sub-hyoides in front and the posterior portion the inter-os-quadrata. In Plethodontidae the two parts in the adult are a more ventral part of the quadrato-pectoralis and the gularis with fascia connections dorsally. These two differ in degree and form in various genera and species.

A cerato-mandibular division of the depressor mandibulae found in some larvae disappears in the adult.

Muscles found in the adult, gill lacking forms are as follows:

In some with attached tongues the genio-glossal may occur. In some Plethodontidae which have a small lingual cartilage such as the genera *Eurecea, Manculus, Pseudotriton* and *Gyrinophilus,* there is the small hypoglossus muscle.

In most free tongued Plethodontidae the surpapendicularis runs across the border of the tongue between the ceratohyals.

LARYNGEAL MUSCLES

M. DILATOR LARYNGEUS, Edgeworth 1920, Francis 1937; dilator aditus laryngis, Henle 1839; dorso-laryngeus et dorso-trachealis, Fischer 1843, Wilder 1892-6; dorso-pharyngeus of dorso-laryngeus und dorso - trachealis, von Goppert 1894 - 8; dorso - laryngeus, Drüner 1901, Osawa 1902.

From the dorsal fascia, inserted on the lateral cartilage of the larynx. Supplied by branches of the 10th cranial nerve.

M. LARYNGEUS DORSALIS ET VENTRALIS, Edgeworth '20, Eaton '36 and others. Eaton recognizes a muscle each side of the larynx from the arytenoid cartilages with attachments to the ventral end of the last muscle. They dialate the larynx.

M. CONSTRICTOR LARYNGIS, Edgeworth '20, Eaton '36, Francis '37; constrictor aditus laryngis, Henle 1839, Fischer 1843, Drüner '01; Ring of periartenoideus dorsalis, Wilder 92-6; spincter laryngis, Goppert 1894-8. This is a ring of muscle about the larynx ventral to the glottis. It receives branches from the 10th cranial nerve. It closes or restricts the cavity of the larynx.

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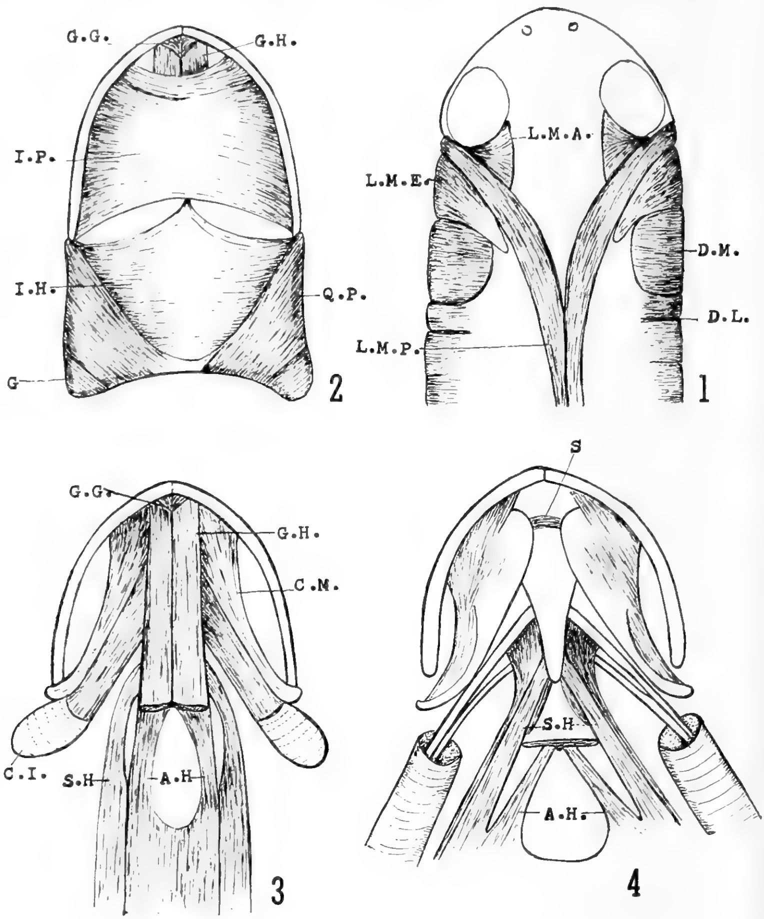

PLATE 1

Diagrams of the head muscles of adult salamanders. 1. From above. 2. From below. 3. Deeper layer from below. 4. Still deeper layer from below.

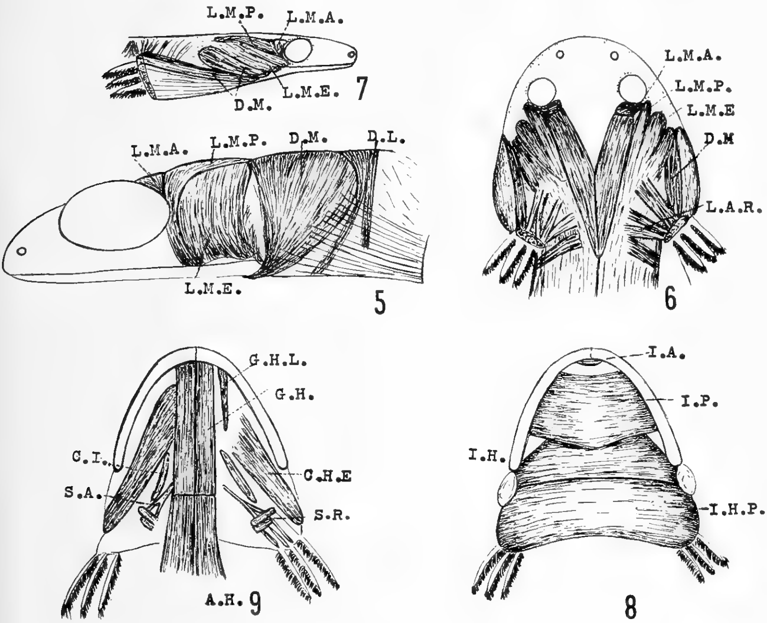

PLATE 2

5. Adult from the side. 6. Larva from above. 7. Larva from the side. 8. Larva from below, superficial muscles. 9. Larva from below, deeper muscles.

INDEX TO FIGURES

A.H., Abdomino-hyoides; C.H.E., Ceratohyoides externus; C.I., Ceratohyoides internus; C.M., Ceratomandibularis; D.L., Dialator laryngis; D.M., Depressor mandibulae; G., Gularis; G.G., Genioglossus; G.H., Geniohyoideus; G.H.L., Geniohyoideus lateralis; I.A., Intermandibularis anterior or submentalis; I.H., Interhyoideus; I.H.P., Interhyoideus posterior; L.A.R., Levatores arcum branchiarum; L.M.A., Levator mandibulae anterior; L.M.E., Levator mandibulae externa; L.M.P., Levator mandibulae posterior; Q.P., Quadrato-pectoralis; S., Suprapendicularis; S.A., Subarcualis obliqui; S.H., Sternohyoideus; S.R., Subarcuales recti.

NEW BATHYPELAGIC AMPHIPODS OF THE GENERA *RHACHOTROPIS* AND *LEPECHINELLA* WITH KEYS TO THE GENERA[1]

By J. LAURENS BARNARD
Allan Hancock Foundation

A single tow with an experimental model of an epibenthic dredge made by Mr. Robert Bieri in waters southwest of Catalina Island, off the coast of southern California, revealed two species of amphipods new to science. The equipment used was aboard the research vessel "E. W. Scripps" of Scripps Institution of Oceanography, La Jolla, California.

These specimens are of importance due to the poorly known bathypelagic amphipod fauna of the eastern Pacific Ocean and the fact that they were recovered on the deeply basined continental shelf where endemic bathypelagic species might occur. However, the precise depth of capture is unknown as the dredge fished from the surface to the bottom.

I am indebted to Mr. Bieri, now of Lamont Geological Observatory, Columbia University, for the donation of the specimens and to the Allan Hancock Foundation for the use of facilities.

Rhachotropis Smith

Rhachotropis Smith, 1883, Proc. U.S. Mus. 6: 222.

Gracilipes Holmes, 1908, Proc. U.S. Nat. Mus. 35: 526.

Below is a key to the existing species of the genus except for the following names:

R. elegans Bonnier has been fused with *R. grimaldii* by K. H. Barnard, 1916, Ann. So. African Mus. 16: 179.

R. gracilis Bonnier is poorly known. See Shoemaker, 1930, Contr. Canadian Biol. Fisheries NS 5 (10): 317.

R. proxima Chevreux, 1911, Bull. Inst. Oceanog. 204: 11.

The description of the armature of the pleon and pleonal epimera is not clear or lacking. However, this species is closely related to *R. faeroensis*.

Gracilipes multicalceolus Thorsteinson, 1941, Univ. Washington Publ. Oceanog. 4 (2): 85-86 has been transferred to the genus *Eusirella* by Birstein and Vinogradov, 1955, Trudy Inst. Okean. Akad. Nauk SSSR 12: 271.

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[1]Contribution No. 185 from the Allan Hancock Foundation, University of Southern California.

KEY TO THE GENUS *RHACHOTROPIS*

1.	Pleon segment 4 bears a dorsal tooth or teeth	2
1.	Pleon segment 4 lacks any dorsal teeth	18
2.	Peraeon segment 7 bears a dorsal tooth	3
2.	Peraeon segment 7 lacks a dorsal tooth	7
3.	Pleon segments have more than one mediodorsal tooth	*ACULEATA* (Lepechin)
3.	Pleon segments have only one mediodorsal tooth	4
4.	Pleon segment 3 not tricarinate	*PLATYCERA* K.H. Barnard
4.	Pleon segment 3 tricarinate	5
5.	Telson not deeply cleft (less than ¼)	*LOBATA* Shoemaker
5.	Telson deeply cleft (more than ¼)	6
6.	Peraeopod 5 longer than the body	*MACROPUS* Sars
6.	Peraeopod 5 not longer than the body	*HELLERI* (Boeck)
7.	Pleon segment 3 lacks an acute mediodorsal tooth	8
7.	Pleon segment 3 bears an acute mediodorsal tooth	11
8.	Pleon segment 1 bears a dorsal tooth	*ANTARCTICA* K.H. Barnard
8.	Pleon segment 1 lacks a well defined dorsal tooth	9
9.	Pleon segments 2-4 not tricarinate	*ANOMALA* K.H. Barnard
9.	Pleon segments 2-4 tricarinate	10
10.	Telson deeply cleft	*PAENEGLABER K.H. Barnard*
10.	Telson not deeply cleft	*ROSTRATA* Bonnier
11.	Pleon segment 3 tricarinate	12
11.	Pleon segment 3 not tricarinate	17
12.	Telson deeply cleft	13
12.	Telson not deeply cleft	16
13.	Lateral carinae of pleon segment 3 obtuse	*HUNTERI* Nicholls
13.	Lateral carinae of pleon segment 3 projecting into points	14
14.	Ventral edge of third pleonal epimeron serrated	*CERVUS* n. sp.
14.	Ventral edge of third pleonal epimeron smooth	15
15.	Eyes small, pigmented, tooth of pleon segment 4 slender	*LOMONSOVI* Gurjanova
15.	Eyes unpigmented, tooth of pleon segment 4 stout	*LEUCOPHTHALMA* Sars
16.	Pleon segment 4 tricarinate*	*KERGUELENI* Stebbing*
16.	Pleon segment 4 not tricarinate	*INTEGRICAUDA* Carausu

*The original description and figures of *R. kergueleni* are unclear as to the tricarination of pleon segments 3-4, but Stebbing (1906, Das Tierreich 21: 349) affirms that they are.

17. Peraeopod 5, lower corner of article 2 angular, produced *FAEROENSIS* Stephensen
17. Peraeopod 5, lower corner of article 2 sloping, unproduced *DISTINCTA* (Holmes)
18. Pleon segment 3 lacks a mediodorsal tooth *INFLATA* (Sars)
18. Pleon segment 3 bears a mediodorsal tooth 19
19. Telson deeply cleft 20
19. Telson not deeply cleft 21
20. Peraeon segment 7 bears a dorsal tooth *OCULATA* (Hansen)
20. Peraeon segment 7 lacks a dorsal tooth *GRIMALDII* (Chevreux)
21. Peraeopod 5, article 2 with large posterior cusp *PALPORUM* Stebbing
21. Peraeopod 5, article 2 lacks posterior cusp 22
22. Rostrum short, pleon with small teeth, pleon segment 3 not tricarinate *NATATOR* (Holmes)
22. Rostrum long, pleon with large teeth, pleon segment 3 tricarinate *SIBOGAE* Pirlot

Rhachotropis cervus, new species

(Plate 3)

DIAGNOSIS. — Rostrum short, eyes absent; none of the peraeon segments dorsally toothed or carinate; each ventral corner of peraeon segment 7 produced backwards into a conical process; pleon segments 1-4 each with an acute, mediodorsal, backward pointing tooth; pleon segments 1-3 tricarinate, each lateral carina produced into a posterior cusp; pleon segment 1 with the lateral cusps but the lateral carinae are not as evident as in segments 2 and 3.

Epimera of pleon segment 3 with ventral edges serrated, posterior edges smooth.

Telson split about ⅓ of its length.

Peraeopod 5: article 2 slightly serrated posteriorly, lower posterior corner not projecting.

Antenna 1 with a minute, uniarticulate accessory flagellum.

Male and female differ only by the female brood plates.

HOLOTYPE. — AHF No. 543, male 7 mm.

TYPE LOCALITY. — 33° 17′ N, 118° 22′ W, epibenthic dredge, 0-1000 m (0-490 fms), Oct. 20, 1954, coll, R. Bieri.

MATERIAL EXAMINED. — Seven specimens from the type locality.

REMARKS. — This species is related to *R. leucophthalma* Sars (1893, Crustacea of Norway 1: 429, pl. 151, fig. 2) but differs in

the following respects: (1) the lower edges of the third pleonal epimera are serrated while posterior edges are smooth; (2) the lobe of article 5 of gnathopods 1-2 is slender; (3) peraeon segment 7 projects backward at each ventral edge; (4) the head lobes are more obtuse; (5) the telson is less deeply cleft.

The new species is also related to *R. lomonsovi* Gurjanova (1934, Zool. Anzeiger 108: 124, fig. 2) but differs by: (1) lack of visible eyes; (2) more obtuse lateral head lobes; (3) lack of posterior serrations and presence of ventral serrations on third pleonal epimera; (4) less deeply cleft telson; (5) the posteroventral projections of peraeon segment 7; (6) the less acute first coxae.

Lepechinella Stebbing

Lepechinella Stebbing, 1908, Jour. Linn. Soc. London, Zool. 30:191. *Dorbanella* Chevreux, 1914, Bull. Inst. Oceanog. 296:1.

KEY TO THE GENUS *LEPECHINELLA*

1. Coxa 1 bifid — 2
1. Coxa 1 not bifid — 3
2. Head processes long, pleon segments 1-3 with 2 teeth only — *ARCTICA* (Schellenberg)*
2. Except for rostrum, head processes short or absent, pleon segments 1-3 with 3 teeth each — *CHRYSOTHERAS* Stebbing
3. Peraeon segments 1-7 lack acute dorsal teeth — *CETRATA* K.H. Barnard
3. Peraeon segments 1-7 bear acute dorsal teeth — 4
4. Peraeon segment 1 with one short dorsal process — *DRYGALSKII* Schellenberg
4. Peraeon segment 1 with two long dorsal processes — 5
5. Coxa 1 very long and attenuated — *ECHINATA* (Chevreux)
5. Coxa 1 moderately long, scarcely attenuated — 6
6. Dorsal pleonal processes much larger than peraeonal, head processes short — *CURVISPINOSA* Pirlot
6. Dorsal pleonal processes similar to peraeonal, head processes long — *BIERII* n. sp.

Lepechinella bierii, new species
(Plates 4, 5)

DESCRIPTION OF FEMALE. — Head with a medial, erect, and slender rostral process, each side of head bears 2 forward projections; eyes absent.

Antenna 1: article 2 about twice the length of article 1, article 3 shorter than 1 and bearing a short, uniarticulate accessory flagellum.

*Senior synonym of *L. schellenbergi* Stephensen

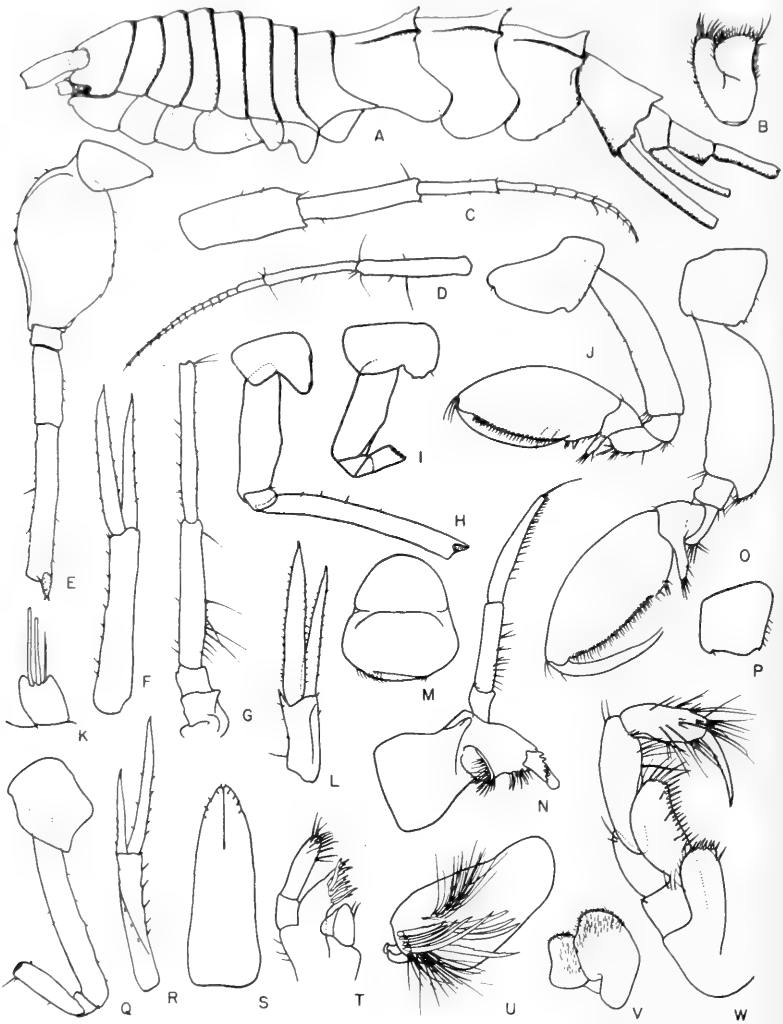

PLATE 3

Rhachotropis cervus, n. sp.

Female, 10 mm. Fig. a, body; b, maxilla 2; c, g, antennae 1-2; e, h, i, q, peraeopods 5, 4, 3, 2; f, r, 1, uropods 1-3; j, o, gnathopods 1-2; k, accessory flagellum; m, upper lip; n, mandible; p, coxa 3; s, telson; t, maxilla 1; u, molar of right mandible; v, lower lip, part; w, maxilliped.

Male, 6 mm. Fig. d, antenna 2.

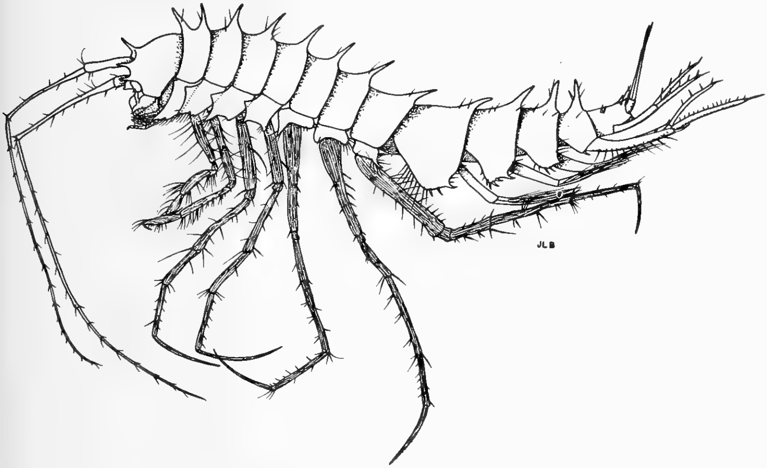

PLATE 4

Lepechinella bierii, n. sp.

Female, 6 mm, holotype. Lateral view.

Antenna 2 slightly longer than 1, article 5 of peduncle not quite twice as long as 4, flagellum shorter than article 5.

Mouthparts similar to the type species, *L. chrysotheras* Stebbing, except for the more slender first maxillary palp and the shorter spines on the inner edge of the inner plate of the maxilliped; the right and left palps of the first maxillae bear different sized spines.

Dorsal processes of segments slender. Peraeon segment 1 bears 2 of these teeth while each of the following segments bears one only; the last two segments of the urosome are fused. The processes of the pleon become successively more erect.

Epimera of pleon segments 1-3 with lower posterior corners produced into curved, conical processes; lower edges of second epimera noticeably excavate anterior to the process.

Coxae 1-2 not bifid, coxae 3-4 bifid, with a web between the downward projecting arms, coxa 5 with a long, conical anterior lobe, coxa 6 slightly bilobed, coxa 7 bearing a ventroposterior, curved process.

Peraeopods 3-5 successively longer, seventh articles successively shorter.

Holotype. — AHF No. 544, female, 6 mm.

Type locality. — 33°17′ N, 118° 22′ W. epibenthic dredge, 0-1000 m (0-490 fms), Oct. 20, 1954, coll. R. Bieri.

Material examined. — Two specimens from the type locality.

Remarks. — The undivided, broad and truncated first coxae, the slender peraeonal processes, and the erect rostral process of the head distinguish this species.

PLATE 5

Lepechinella bierii, n. sp.

Female, 6 mm, holotype. Fig. a, outer plate of maxilliped; b, article 7 of peraeopod 2; c, mandible; d, k, gnathopods 2, 1; e, left and right palps of maxilla 1; f, telson; g, palp article 4, maxilliped; h, uropod 3; i, inner plate of maxilliped; j, accessory flagellum, stippled.

TWO SPECIES OF BRYOZOA CTENOSTOMATA FROM THE SALTON SEA[1]

By JOHN D. SOULE*

While in the process of sorting the invertebrate animals collected at various stations in the Salton Sea, Mr. Richard H. Linsley, biologist with the University of California Salton Sea Laboratory, noted three collecting bottles covered with colonies of actenostome bryozoan. Upon receipt of this material from Mr. Linsley, it was discovered that not one, but two species of Bryozoa Ctenostomata were represented, namely *Nolella blakei* Rogick, 1949 and *Victorella pavida* Kent, 1870. In each instance, the only prior report of the species in the United States had been from the Atlantic coast.

The author wishes to take this opportunity to express his gratitude to Mr. Richard H. Linsley of the University of California Salton Sea Laboratory for his interest and cooperation in not only providing the specimens, but in also furnishing a faunal list of associated invertebrates. To Dr. Mary D. Rogick of the College of New Rochelle, I acknowledge my appreciation for her generous aid in confirming the identification of *Nolella blakei.*

Nolella Gosse, 1855

Nolella blakei Rogick, 1949

1949 *Nolella blakei* Rogick, Biol. Bull., vol. 97, no. 2, pp. 158-168, pl. 1, figs. 1-4, pl. 2, figs. 5-8, pl. 3, figs. 9-14, pl. 4, figs. 15-19.

Colonies of *Nolella blakei* were found growing in great profusion covering the walls of a test bottle suspended in the Salton Sea for a period of one month at a depth of about one meter.

The zoids, or individuals of the colony, are cylindrical, arising from an irregular flattened adnate base. In over-all dimensions, including the basal area, the mature zoids range from individuals as short as 320 microns to those that have attained a length of 1150 microns. In width the variation is not extreme, ranging from 110 microns to 140 microns. The cuticle of the older zoids is almost imperceptibly covered with a fine grained layer of silt, to the extent of being moderately argillaceous. The basal portion of the younger zoids are decidedly expanded and flattened, exhibiting from 6 to 14 lateral branches. Some of these lateral branches

[1]Contribution number 186 from the Allan Hancock Foundation.

*Allan Hancock Foundation, University of Southern California, Los Angeles, Calif.

are short, diminutive and narrow. Others are wider, longer, provided with a diaphragm or septum, and constitute a stolonal connection to an adjacent zoid. The longer, older zoids have a much less pronounced basal expansion with a reduced number of lateral branches.

The polypide is provided with 8 tentacles. The lower portion of the cardium is expanded immediately before it joins the caecum, to form a grinding organ that is more the nature of a proventriculus than a gizzard (pl. 6, fig. 1). *Geographical distribution*: Atlantic. Lagoon Pond, Martha's Vineyard, Massachusetts. August 1946. Collector, Mary D. Rogick.

Occurence: Salton Sea, California, station 6, north end of the Salton Sea, 33° 31′N - 116° 02′W, depth 1.2 meters. Salinity 32.5/00 fairly constant. August 1955. Collector, Richard H. Linsley, University of California Salton Sea Laboratory.

Victorella Kent, 1870

Victorella pavida Kent, 1870

1870 *Victorella pavida* Kent, Quart. Jour. Micro. Sci., vol. 10, n.s., pp. 34 - 39, pl. 4, figs. 1-3.

1880 *Victorella pavida,* Hincks, Hist. Brit. Mar. Polyzoa., pp 561, 562, pl. 79, figs. 4-7.

1885 *Victorella pavida,* Bousfield, Ann. Mag. Nat. Hist., ser. 5, vol. 16, pp. 401-407, pl. 12, figs. 1-3.

1887 *Victorella pavida,* Kraepelin, Abh. Geb. Naturw., Hamburg, band 10, pp. 93-96, pls. 3, 4, figs. 75, 78, 91, 92, 118.

1887 *Paludicella Mülleri* Kraepelin, Abh. Geb. Naturw., Hamburg, band 10, pp. 158-160 (footnote), text figs. a & b.

1907 *Victorella pavida,* Annandale, Rec. Ind. Mus., vol. 1, pp. 200-203 text figs. 3 & 4.

1908 *Victorella bengalensis* Annandale, Rec. Ind. Mus., vol. 2, pp. 11-13, fig. 1.

1911 *Victorella pavida,* Annandale, Fauna Brit. India, pp. 194, 195.

1911 *Victorella pavida,* Annandale, Rec. Ind. Mus., vol. 6, pp. 196, 197, pl. 13, fig. 5.

1911 *Victorella mülleri,* Annandale, Rec. Ind. Mus., vol. 6, p. 196, pl. 13, fig. 4.

1911 *Victorella bengalensis,* Annandale, Rec. Ind. Mus., vol. 6, p. 197, pl. 8, figs. 3, 7 & 8.

1915 *Victorella bengalensis,* Annandale, Mem. Ind. Mus., vol. 5, p. 125.

1932 *Victorella pavida,* Osburn, Ohio Jour. Sci., vol. 32, no. 5, p. 445, pl 1, fig. 5.

1936 *Victorella pavida*, Vorstman, Flora en Fauna Zuiderzee, supp., pp. 148, 149, text figs. 5, 6.

1940 *Victorella pavida*, Marcus, Danmarks Fauna, Mosdyr, pp. 329, 330, text fig. 173.

1944 *Victorella pavida*, Osburn, Chesapeake Biol. Lab. pub. 63, pp. 17-20, pl. 5, and text fig. 10.

1951 *Victorella pavida*, Braem, Zoologica, Stuttgart, band 37, heft 102, pp. 7-23, pl. 1, figs. 2-8, pl. 2, figs. 10-12, figs. 14-20, pl. 3, figs. 22-35, pl. 4, figs. 36-44.

1951 *Tanganella Mülleri* Braem, Zoologica, Stuttgart, band 37, heft 102, pp. 23-33, pl. 1, fig. 9, pl. 5, figs 45-53, pl. 6, figs. 54-61, pl. 8, figs. 69, 70.

1951 *Victorella pavida* forma *symbiotica*, Lacourt, Expl. Hydrobiol. Lac Tanganika, Res. Sci., vol, 3, fasc. 2, pp. 24, 25.

1953 *Victorella pavida*, Marcus, Arq. Museu Nac., vol. 42, pp. 312, 313, pl. 8, fig. 94.

1954 *Victorella pavida*, Brattstrom, Lunds Univer. Arsskrift, Avd 2, band 50, nr. 9, pp. 1-29, 1 pl., 4 text figs.

1956 *Victorella pavida*, Toriumi, Sci. Rep. Tôhoku Univer., 4, ser. (Biology), vol. 22, no. 2, p. 82, figs 1-3.

The zoaria or colonies of *Victorella pavida* form a luxuriant tan to yellowish brown colored mat upon the substratum. The specimens in this collection were removed from the sides of two test bottles, each exposed for a period of 30 days in the Salton Sea at a depth of about one meter. In 1944 Osburn described colonies of *Victorella pavida* from Chesapeake Bay as capable of "spreading over almost any sort of substratum on which it can find attachment". The abundance of this species during the warm summer months is enough so as to regard it as a potential fouling organism.

The zoids of *Victorella pavida* are variable in their dimensions, a factor that has been noted by several of the earlier authors (Bousfield, 1885; Osburn, 1944; Braem, 1951; and Marcus, 1953). With regard to those collected from the Salton Sea, short repent, mature individuals with a total length of only 345 microns were found. Within the same colony, many exceedingly elongated individuals were measured. The longest was found to have a length of 4850 microns. In width the variation is not great, ranging from 126 microns to 196 microns.

The tall zoids are cylindrical, arising from limited expanded portions of the stolon. The basal expansion may exhibit two, three or even four short lateral branches. A number of the longer mature zoids (primary) have functional secondary zoids budding directly from the cuticle. While the secondary zoids never attain the maximum length of the primary individuals, in all other anatomical respects they can be considered as normal members

of the colony (pl. 6, fig. 2). *Geographical distribution:* The only place in the United States from which *Victorella pavida* has been reported prior to this time is Chesapeake Bay, Maryland (Osburn, 1932, 1944). For an excellant summary of the worldwide distribution of this species see Brattstrom, 1954.

Occurence: Salton Sea, California, station 7, south side of Mullet Island, 33° 13.5'N - 115° 36.5'W, depth 1.0 meters, October 1955. Station 8, .75 miles north east of Mullet Island, 33° 14'N - 115° 35.7' W, depth 0.8 meters, August 1955. Salinity at stations varies considerably due to the influence of the water from the mouth of the nearby Alamo River. Brackish.

Associated invertebrates: Neanthes succinea (Frey & Leuckart), *Balanus amphitrite saltoensis* Rogers, *Brachionus plicatilis* Müller, and *Cyclops dimorphus* Kiefer.

Taxonomic affinity: As was noted above, the zoids of *Victorella pavida* exhibit considerable variation in length. The short individuals of the colony, *ie* the younger zoids, appear to be anatomically identical with the zoids of the species described in 1887 by Kraepelin as *Paludicella Mülleri*, later referred to as *Victorella mülleri* by Annandale, 1911, and in 1951 redescribed by Braem as *Tanganella Mülleri*. The taxonomic history of *Victorella mülleri* is diverse. While a few authors have accepted it as a well-defined species, the majority are of the opinion it is at least very closely related, if not identical with *Victorella pavida*. Most authors who have studied the European material have considered the two identical. Brattström, 1954, pp. 8-12, summarizes the various views, including the work of Kraepelin (1887) who described *Paludicella Mülleri;* Braem, (1911) who at that time considered *Victorella mülleri* a growth phase of *Victorella pavida;* Annandale, (1911) who stated that while four "species" can be distinguished in the genus *Victorella*, it might be better to regard them as varieties or as subspecies of *Victorella pavida*. Annandale also found with regard to *Victorella mülleri*, intermediate stages between the "form *mülleri*" and the *Victorella* associated with it, *V. pavida*. Brattström (1954) also reviews the work of Vanhöffen, (1917) who considered *Victorella mülleri* a growth form of *V. pavida*, as did Ulrich, (1926). Marcus (1940) and Valkanov (1943) also considered the two as being identical. Toriumi (1956) stated that *Victorella mülleri* is a "phenotype" of *V. pavida*.

Although Osburn (1944) did not have the opportunity to discuss *V. mülleri*, his figures 10c, 10d, and 10f of early growth stages, lend support to the authors who consider the two species identical. The close similarity of Osburn's figures mentioned and those of Braem (1951), plate 5, fig. 47 of *Tanganella Mülleri* is unmistakable. Osburn's (1944) measurements of *V. pavida* from

Chesapeake Bay correspond very closely to those given later by Braem for the Greifswald material.

Annandale (1911) separated *Victorella pavida* from *V. mülleri* on the premise that *V. mülleri* has parietal muscles present in the distal tip of the zoids, whereas *V. pavida* does not. Examination of the Salton Sea specimens, as well as slides made by Osburn from the Chesapeake Bay collection reveal Annandale's assertion to be erroneous. *Victorella pavida* possesses parietal muscles in the distal tip of the zoids.

It seems paradoxical that one author can derive two genera from material considered by other authors to be a single well known and widely distributed species. Braem (1951) erected the genus *Tanganella* on the basis of, (a) the morphology of the cardia and the presence of a sphincter muscle in the foregut of the polypide; (b) the small size of the zoids; and (c) the number of the "Kragenfalten".

With regard to item (a) above, Braem, reported a ventricose enlargement of the cardia in *V. pavida* with the conclusion that it is a grinding mill lacking in dentition *ie* proventriculus. This agrees with findings of earlier authors such as, Osburn, 'proventriculus,' (1944); Marcus, 'tyggemave,' (1940); and Bousfield, 'gizzard,' (1885). With reference to *Tanganella Mülleri*, Braem makes no mention of a proventriculus, although the sphincter musculature of the foregut is thoroughly discussed. However, two of Braem's illustrations of *T. Mülleri* (pl. 5, figs. 49 and 51) show every indication of the presence of a proventricular division of the cardia. Examination of the Salton Sea collection and the Chesapeake Bay specimens, and a comparison with Braem's work indicates that essentially there is no marked anatomical dissimilarity that would separate a species *mülleri* from *Victorella pavida* let alone warrant the erection of a separate genus.

Consider next Braem's second item, the length of the zoid. As shown by many earlier authors as well as by the examination of the Salton Sea material this is not a valid criterion for the separation of a distinct genus. In a given colony both short zoids of the *mülleri* type occur in numbers intermingled with the predominate greatly elongated individuals considered typical of *Victorella pavida*. The *mülleri* type zoid is to be considered as a growth phase encountered in the younger colonies of *Victorella pavida*.

The third item, the "Kragenfalten" or collar folds, are subject to a high degree of individual variation. There are variations produced in the contraction of individual zoids such as differences produced by various fixatives and preservatives. These variations are much too great to stand as a reliable criterion.

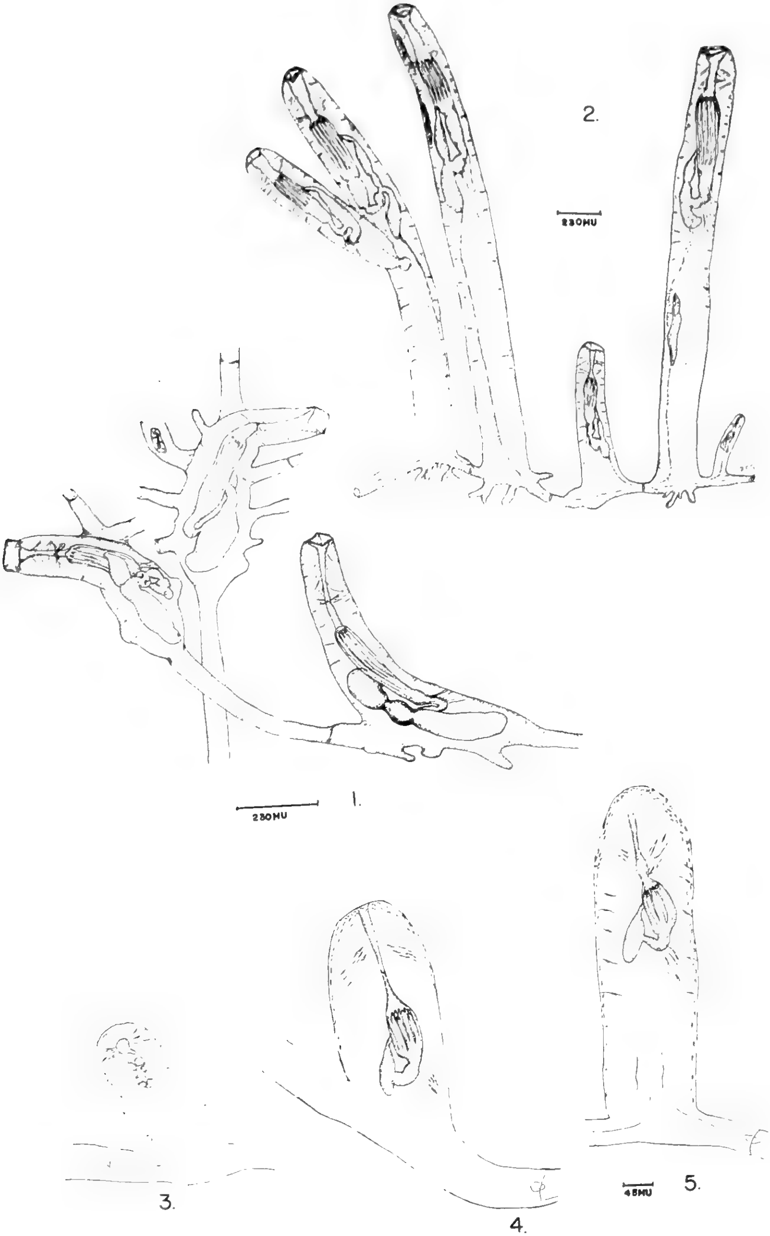

PLATE 6

The conclusions of Braem (1951) in view of the above discussion seem to be extreme. In my opinion, *Victorella pavida* Kent, 1870 and *Tanganella Mülleri* Braem, 1951 are to be considered as identical.

In a paper on post-larval development with relation to the classification of the ctenostome Bryozoa, Soule (1954) noted that the specimens of *Victorella* then available were inadequate for the study of the developing polypide. However, with an abundance of new material from the Salton Sea collection, it is now possible to follow the post-larval development of the polypide within the forming zoids. As a result of the study, certain modifications in the ctenostome classification are in order.

The scheme of classification as developed in the earlier paper is based upon the sequence of appearance of the three major muscle groups; parietal, retractor, and the apertural, as the polypide is being formed. It was noted in the 1954 paper that there are two basic systems of procedure in the sequence of appearance of the major muscle groups. This divides the ctenostomes into two divisions, the incrusting group called Carnosa, and the stolonate group known as Stolonifera. In the 1954 classification, the genus *Victorella* was included in the first division, Carnosa, under the family Victorellidae, along with the genera *Paludicella, Pottsiella,* and *Arachnoidia.* This must be changed. Upon the examination of Salton Sea specimens, *Victorella pavida,* it was found that the *apertural* muscle group appeared first as the polypide developed (pl. 6, fig. 3). The second muscle group to makes its appearance is the *retractor,* (pl. 6, fig. 4), and a little later the *parietal* group appeared (pl. 6, fig. 5). This sequence of muscle group develop-

DESCRIPTION OF FIGURES ON PLATE 6

Fig. 1. *Nolella blakei.* A portion of a colony illustrating the morphology of three mature zoids.

Fig. 2. *Victorella pavida.* A portion of a colony showing the morphology of four mature primary zoids. Note the variation in length. One primary zoid has given rise to a secondary zoid.

Fig. 3. *Victorella pavida.* Early developing zoid. Note incipient polypide. With regard to the musculature, only the apertural muscle group is in evidence.

Fig. 4. Further development of a zoid. Tentacles forming. Polyide assuming characteristic morphology. The second muscle group to make its appearance, the retractor, has been added.

Fig. 5. A developing zoid in a yet later stage, exhibiting the addition of third and last muscle group to appear, the parietal.

ment is typical of the sequence that occurs in the division Stolonifera, obviously ruling out *Victorella* as a member of the division Carnosa. The classification is modified as follows.

BRYOZOA Ehrenberg, 1831
Suborder CTENOSTOMATA Busk, 1852
Division I. CARNOSA Gray, 1841

Family ALCYONIDIIDAE Johnston, 1849
Alcyonidium Lamouroux, 1813
Benedenipora Pergens, 1888
Lobiancopora Pergens, 1888

Family FLUSTRELLIDAE Hincks, 1880
Flustrella Gray, 1848
Elizerina Lamouroux, 1816

Family PHERUSELLIDAE Soule, 1953
Pherusella Soule, 1951

Family CLAVOPORIDAE Soule, 1953
Clavopora Busk, 1874

Family PALUDICELLIDAE Allman, 1844
Paludicella Gervais, 1836
Pottsiella Kraepelin, 1887

Family ARACHNIDIIDAE Hincks, 1880
Arachnidium Hincks, 1877
Arachnoidia Moore, 1903
Platypolyzoon Annandale, 1912
Sundanella Braem, 1939
Anguinella van Beneden, 1845
? *Hislopia* Carter, 1858

Division II. STOLONIFERA EHLERS, 1876
Group A. Vesicularina Waters, 1910

Family NOLELLIDAE Harmer, 1915
Nolella Gosse, 1855
Victorella Kent, 1870

Family VESICULARIIDAE Johnston, 1838
Vesicularia Thompson, 1830
Amathia Lamouroux, 1812
Bowerbankia Farre, 1837
Zoobotryon Ehrenberg, 1831
?*Avenella* Dalyell, 1847
?*Cryptopolyzoon* Dendy, 1889
Group B. Valkerina Silén, 1942

Family WALKERIIDAE Bassler, 1953
Walkeria Fleming, 1823
Aeverrillia Marcus, 1941
Monastesia Jullien, 1888

Family MIMOSELLIDAE Hincks, 1851
Mimosella Hincks, 1851
Hypophorella Ehlers, 1876

Family BUSKIIDAE Hincks, 1880
Buskia Alder, 1857

Family TRITICELLIDAE G.O. Sars, 1874
Triticella Dalyell, 1848
Farrella Ehrenberg, 1834

Group C. Terebriporina Soule, 1953

Family TEREBRIPORIDAE d'Orbigny, 1847
Terebripora d'Orbigny, 1847
Spathipora Fischer, 1866

Family IMMERGENTIIDAE Silén, 1946
Immergentia Silén, 1946

Family PENETRANTIIDAE Silén, 1946
Penetrantia Silén, 1946

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FOUR NEW PORCELLAIN CRABS FROM THE EASTERN PACIFIC[1]

By JANET HAIG
Allan Hancock Foundation,
University of Southern California

In the course of studies on west American Porcellanidae, the writer has recognized several new forms. It seems advisable to describe some of them in advance of the complete report, publication of which may be delayed several years.

All type material of the four species described below is deposited in the collections of the Allan Hancock Foundation. The illustrations are the work of Russell D. Cangialosi.

Pachycheles spinidactylus, new species

Plate 7, figs. 1-4

DESCRIPTION. — Carapace subquadrate, about as broad as long or slightly broader; surface faintly rugose, especially on posterolateral margins, obscurely granular anteriorly; front with a tuft of plumose hairs and setae, and a few plumose hairs on protogastric regions and elsewhere anteriorly. Preorbital angles slightly produced; front narrow, rounded or sinuous in dorsal view, trilobate in frontal view. Postorbital angle produced into a low, broad tooth. Separated portion of lateral wall consists of one large piece and sometimes a number of fragments.

First movable segment of antenna with a lobe, sometimes spine-tipped, on anterior margin; second and third granular; flagellum naked. Outer maxillipeds faintly rugose.

Merus of chelipeds rugose dorsally; anterior margin with a broad, rugose, granulate-edged lobe; ventral surface smooth. Carpus armed on anterior margin with three spine-tipped teeth, a fourth occasionally present; dorsal surface covered with large conical tubercles, larger and more projecting toward posterior margin; from the bases of these tubercles arise tufts of long, stiff setae and short plumose hairs, and scattered between the tubercles are short setae; posterior margin sometimes with a fringe of long plumose hairs; ventral surface smooth. Chela covered dorsally with tubercles and hairs in an arrangement similar to that on carpus; granules along outer margin elongate and pointed, forming a serrate edge; ventral surface with flattened

[1]Hancock Foundation Contribution No. 187. This study was supported by a grant from the National Science Foundation.

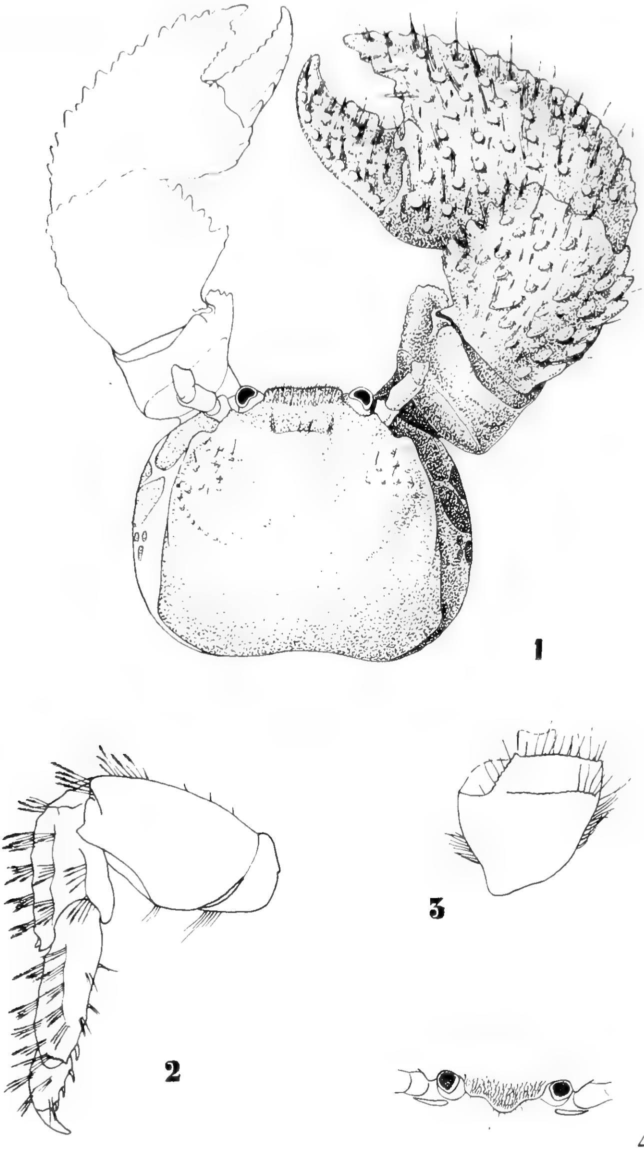

PLATE 7

Pachycheles spinidactylus, n. sp.: 1, Male holotype, X 5; 2, left first walking leg, X 7½; 3, basal segment of left antennule in ventral view, X 20; 4, front in anterior view, X 5.

granules, naked except for a few tufts of short setae along outer margin. Dactyl of major chela with a row of rounded or pointed tubercles near outer margin, tip slender and curved; pollex spined on outer margin; fingers gaping, not quite meeting at tips. Dactyl and pollex of minor chela margined with a row of spines, extending nearly to tips; fingers meet entire length and cross at tips. In both chelae, a few short setae and plumose hairs in gape of fingers.

Walking legs faintly rugose, all segments with long plumose hairs and setae.

Sternum smooth; abdomen smooth or punctate, telson with seven plates.

No pleopods in male.

MEASUREMENTS. — Length of holotype, 7.3 mm; width, 7.7 mm.

TYPE. — Holotype, male, AHF 561, from Islas Las Tres Marietas, Bahía de Las Banderas, Mexico, shore; March 21, 1956; collected by Jens W. Knudsen.

COLOR. — In alcohol, recently collected specimens are reddish orange, the tips of the fingers white; the setae are straw-colored.

DISTRIBUTION. — Specimens in the collection of the Hancock Foundation range from Isla Isabel south to Acapulco, Mexico, and from shore to four fathoms.

HABITAT. — Taken under stones in the littoral, and from sponges.

REMARKS. — *Pachycheles spinidactylus* resembles *P. panamensis* Faxon, also a west American species, in having stiff setae on the chelipeds and walking legs, and seven plates in the telson of the abdomen. In *P. panamensis* there are no plumose hairs on the chelipeds and walking legs, the anterior margin of the carpus is armed with only two teeth, and a pair of pleopods is present in the male. The new species is more closely related to *P. pilosus* (H. Milne Edwards) from the Caribbean and to *P. barbatus* A. Milne Edwards from West Africa, both of which have only five plates in the telson of the abdomen.

Petrolisthes glasselli, new species
Plate 8, figs. 1-3

Petrolisthes amoenus Boone, 1932, Zoologica 14: 41, text-figs. 11-12. Not *P. amoenus* (Guérin).

DESCRIPTION. — Carapace a little longer than broad; covered with distinct piliferous striations, except on the frontal region, which is granulate, and the intestinal region, which is punctate; striae interrupted at the cervical and branchial grooves. Front faintly pubescent, triangular, deflexed and truncate at tip, with a deep median sulcus extending to protogastric lobes; a small preorbital spine, scarcely distinct in larger specimens. Orbits deep, their margins granulate; postorbital tooth broad and produced into a small spine. An epibranchial spine at cervical groove,

followed by a second spine on epibranchial region between cervical and mesobranchial grooves.

First movable segment of antenna with a small, spine-tipped, lamellar lobe; second and third nearly smooth; flagellum naked. Outer maxillipeds rugose.

Chelipeds covered dorsally and ventrally with piliferous striations, which are granulate on margins; striae less distinct on ventral suface. Merus with a large serrate tooth on anterior margin.

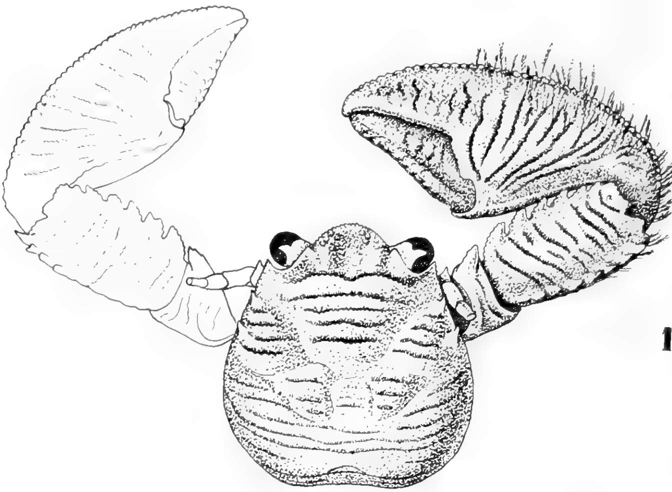

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PLATE 8

Petrolisthes glasselli, n. sp.: 1, Male holotype, X 3; 2, left first walking leg, X 3½; 3, basal segment of left antennule in ventral view, X 10.

Carpus less than twice as long as wide; armed with a row of five serrate teeth on anterior margin, a sixth occasionally present; striations continue obliquely across dorsal surface. Striations on palm continue obliquely and unbroken across dorsal surface except on margins, where they break up into flattened tubercles; outer half of palm often with a fringe of plumose hairs. Rugae on pollex short, interrupted by a groove which runs down its center; rugae on dactyl interrupted near outer margin by a deep, broad groove extending from near tip to articulation with manus. Gape of fingers nearly smooth, without pubescence.

Walking legs faintly rugose on dorsal surface; all segments with long scattered setae, and merus with a fringe of plumose hairs on anterior margin. Merus of leg 1 with a row of six to eight spines on anterior margin; of leg 2, with eight to ten; of leg 3, with six or seven. A single posterodistal spine (a second rarely present) on merus of legs 1 and 2.

Sternum smooth; abdomen smooth or lightly rugose, telson with seven plates.

MEASUREMENTS. — Length of holotype, 11.0 mm; width, 10.1 mm. Length of largest female paratype, 10.2 mm; width, 9.5 mm.

TYPES. — Holotype, male, AHF 352, from station 435-35, Bahía Octavia, Colombia, taken from coral; January 28, 1935; collected by VELERO III. Paratypes, two males and six females (three ovigerous), same locality and date.

COLOR. — The color in life was not recorded. In alcohol most specimens are strikingly marked, having a strong stripe of deep purplish-red along each striation of the carapace, and stripes across the intestinal and frontal regions. The chelipeds are similarly striped, and the walking legs and abdomen are striped or spotted.

DISTRIBUTION. — Specimens in the collection of the Hancock Foundation range from Islas Las Tres Marias, Mexico, south to the type locality, and from shore to four fathoms. The specimens recorded by Boone (1932) as *Petrolisthes amoenus* were from the Galápagos Islands.

HABITAT. — This crab is occasionally found under stones in the littoral, but it occurs more frequently and abundantly in colonies of *Pocillopora* coral.

REMARKS. — *Petrolisthes glasselli* belongs to a group of closely related *Petrolisthes* characterized by the presence of strong transverse striations on the carapace, three to five teeth on the anterior margin of the carpus of the chelipeds, and a row of spines

on the anterior margin of the walking legs. It differs from all other eastern Pacific members of the group in having two epibranchial spines on each lateral margin instead of one.

That the late Steve A. Glassell was aware of the existence of this species and had intended to describe it is indicated by notes in his handwriting among papers and specimens in the Hancock Foundation. The present writer is pleased to dedicate the species to Mr. Glassell, in recognition of his many contributions to the knowledge of west American Porcellanidae.

Petrolisthes diffractus, new species

Plate 9, figs. 1-6

Description. — Carapace about as broad as long; covered with large, flattened granules, which are smaller on the frontal region, take the form of distinct plications on the lateral regions, and are absent only on the intestinal region, which is smooth or punctate; regions not distinct. Frontal region slightly depressed; front trilobate, the lobes strongly projecting, extending beyond eyes, the center lobe triangular and rounded at tip, the outer ones truncate; in dorsal view the three lobes appear about equal in length, but in frontal view the center lobe shows a long, acute, strongly deflexed extension. Orbits with margins straight, strongly oblique; on each side a small preorbital lobe separated by a notch from outer frontal lobe; postorbital tooth projecting at right angle to orbit, strongly produced. No epibranchial spine. Posterior portion of lateral wall broken up into numerous very small pieces, narrowly separated from each other by membrane.

First movable segment of antenna with a strongly projecting, finely granulate, lamellar lobe; second with a double row of large, strongly projecting nodules on anterior margin, and scattered smaller granules on sides and ventral surface; third nodular on anterior margin, more or less smooth; flagellum naked. Outer maxillipeds rugose.

Merus of chelipeds covered dorsally with flattened granules; armed with a small pointed lobe, only slightly projecting, on anterior margin; ventral surface smooth or punctate. Carpus one and a half to two times as long as wide; covered dorsally with rough, rounded granules, more projecting than those of carapace; armed on anterior margin with four strongly projecting teeth, denticulate on edges, the proximal one projecting at right angles to the carpus, others tilted progressively forward, with the distal tooth lying nearly parallel with the long axis of the carpus; posterodistal angle produced into a curved spine; dorsal surface

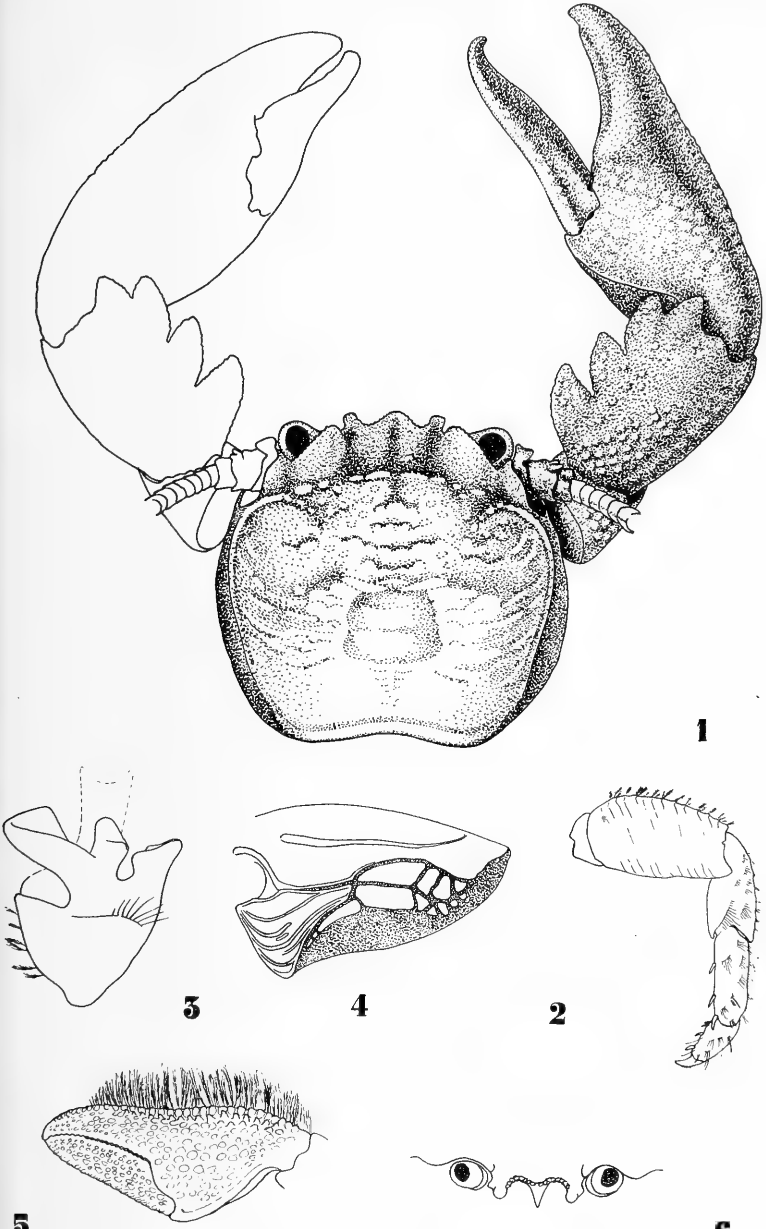


PLATE 9

Petrolisthes diffractus, n. sp.: 1, Male holotype, X 7; 2, right first walking leg, X 5; 3, basal segment of left antennule in ventral view, X 10; 4, left side wall of carapace, membrane indicated in stipple, X 5; 5, right chela of female in dorsal view, X 5; 6, front in anterior view, X 5.

usually with a fine pubescence, not obscuring the granules; ventral surface smooth or punctate, without pubescence. Chela covered dorsally with granules similar to those on carpus; faintly granular on ventral surface; outer margin of palm with a row of small granules, which are sometimes produced into spinules to about base of pollex; this same portion of outer margin often provided with a thick brush of soft hairs, usually present in females and absent in males. Fingers usually dissimilar in the two chelae: in one chela, they meet entire length, with a row of fine granules along cutting edges, dactyl strongly curved at tip; in the other, the fingers are shorter, blunt at tips, gaping, dactyl more evenly curving, its cutting edge with a large, rounded tooth and a row of smaller granules. In some specimens, fingers of the first type are present on both chelae. Only a slight trace of pubescence in gape of fingers.

Walking legs rugose; all segments with tufts of setae, and merus fringed on anterior margin with plumose hairs. No anterior or posterodistal spines on merus.

Sternum and abdomen smooth; telson with five plates.

Measurements. – Length of holotype, 6.3 mm; width, 5.7 mm. Length of largest female paratype, 8.3 mm; width, 8.6 mm.

Types. – Holotype, male, AHF 542, from station 2591-54, San Lorenzo Rocks, Acapulco, Guerrero, Mexico, shore; January 30, 1954; collected by J. S. Garth from velero iv. Paratypes, three males and four ovigerous females, same locality and date.

Color. – In alcohol, specimens are a pale reddish orange, the color somewhat darker on granules and tips of the fingers.

Distribution. – In addition to the type series, the Hancock Foundation collection contains a single specimen from Bahía Tenacatita, Mexico.

Habitat. – All the specimens were taken under stones in the littoral.

Remarks. – Every female specimen examined had a brush of hair on the outer margin of the chela, as described above; with one exception, a young 3.2 mm individual, every male lacked this brush of hair. From the comparatively small sample now at hand, it appears that the presence of this hair is distinctly a female character.

Petrolisthes diffractus belongs to a homogenous group of which the only other members are *P. vanderhorsti* Schmitt and *P. nodosus* Streets, both from the Caribbean area. The three differ from all other *Petrolisthes* in having the side walls of the carapace

broken up into numerous small pieces. *P. diffractus* differs from both Atlantic species in having a more roughly granular carapace and chelipeds, and in the conformation of the frontal lobes. It is closer to *P. vanderhorsti,* from which it differs in having broader, less pointed carpal teeth.

The name is from the Latin *diffractus,* broken in pieces or shattered, in reference to the peculiar structure of the side walls of the carapace.

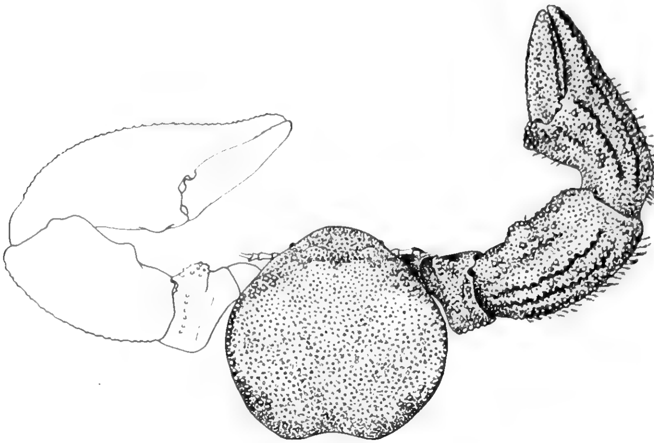
Megalobrachium garthi, new species

Plate 10, figs. 1-5

Description — Carapace about as broad as long, very strongly convex dorsoventrally, highest at gastric region, from which point it slopes abruptly downward; hepatic, protogastric, and sometimes cardiac areas slightly projecting, but regions not strongly marked except in young specimens; entire surface thickly covered with very small, shallow pits, visible only under a lens; lateral margins granulate; surface naked or with scattered plumose hairs. Front rounded in dorsal view; trilobate in frontal view, the outer lobes broad, straight or sinuous, scarcely projecting, the center lobe narrow, triangular, separated by a notch from outer lobes and slightly projecting beyond them; entire front projects like a shelf in front of basal segment of the antennules. Eyes small, partly visible in dorsal view.

Basal segment of antenna pitted like carapace; movable segments pitted and slightly granular, third with a long, narrow posterodistal projection; flagellum naked. Outer maxillipeds pitted like carapace.

Merus of chelipeds covered dorsally with pits and coarse granules; anterior margin with a broad, granular, strongly projecting lobe; ventral surface pitted like carapace. Carpus pitted and coarsely granular dorsally, the granules more projecting toward posterior margin; anterior margin with a small rounded lobe a little proximad of the center; surface naked or lightly pubescent, with two longitudinal grooves joined at proximal end; ventral surface covered with pits and coarse granules. Manus pitted and coarsely granular dorsally, naked or lightly pubescent, with three longitudinal crests, the first extending to base of dactyl, second to base of pollex, third onto pollex; these crests defined by broad grooves, in each of which is a row of deep pits; ventral surface with flattened or coarse granules and small pits like those of carapace. Fingers with small flattened or coarse granules dorsally, ventral surface smooth or lightly pitted; gaping in one chela, usually meeting entire length in other chela; gape without pubescence.



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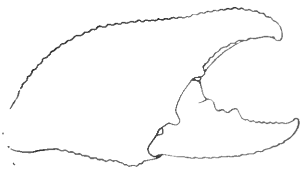

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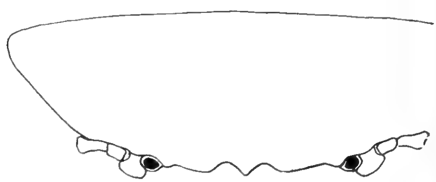

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PLATE 10

Megalobrachium garthi, n. sp.: 1, Male holotype, X 3½; 2, right first walking leg, X 7½; 3, basal segment of left antennule in ventral view, X 20; 4, left chela of holotype in dorsal view, X 3½; 5, front in anterior view, X 7½.

Walking legs covered dorsally and ventrally with pits like those of carapace. Merus, carpus, and propodus with crests on anterior margins; carpus and propodus crested on dorsal surface.

Sternum pitted, divided into two parts by a deep longitudinal suture. Abdomen pitted, telson with five plates.

MEASUREMENTS. — Length of holotype, 7.8 mm; width, 7.9 mm. Length of female paratype, 6.6 mm; width, 6.6 mm.

TYPES. — Holotype, male, AHF 409, from station 1042-40, Isla Turner south of Isla Tiburón, Gulf of California, Mexico, shore; January 24, 1940; collected by VELERO III. Paratype, one female, same locality and date.

COLOR. — In alcohol, recently collected specimens are pale orange brown. The tips of the fingers are white, and there is a broad longitudinal white stripe on the carapace.

DISTRIBUTION. — Specimens in the collection of the Hancock Foundation range from the type locality in the Gulf of California south to Bahía Tangola-Tangola, Mexico, and from shore to four fathoms.

HABITAT. — Specimens were occasionally taken under stones in the littoral, and more commonly from sponges and coral.

REMARKS. — *Megalobrachium garthi* resembles *M. sinuimanus* (Lockington) in having a lobe on the anterior margin of the carpus. It is pitted like *M. erosa* (Glassell), but in that species much of the surface is strongly eroded. Both *M. sinuimanus* and *M. erosa* have seven plates in the telson of the abdomen.

The new species is named in honor of Dr. John S. Garth of the Allan Hancock Foundation, who has added greatly to the knowledge of Pacific American Crustacea.

NOTES ON THE EARLY STAGES OF TWO WESTERN AMERICAN MOTHS

By John Adams Comstock
Del Mar, California

Among the many scores of species of moths taken at light on my home grounds in Del Mar, there are a number that have defied my efforts to obtain information as to their early stages.

Two species in particular have proven puzzling. One is a small arctiid, *Cisthene nexa* Bdv., which has been recorded by Henry Edwards as feeding on lichens.[1]

The other is a phalaenid, *Agriopodes viridata* Harv., concerning which nothing is known as to food plant or metamorphosis.

It required a collecting trip to Baja California, and the valued cooperation of Dr. F. X. Williams, to solve the problem.

On September 10, 1955, a group of naturalists were camped in a canyon about two miles east of San Simón, Baja California. The party included two other entomologists that were particularly interested in lepidoptera, in addition to the writer, namely, Dr. F. X. Williams, and Charles F. Harbison.

The floor of the canyon was heavily overgrown with the Box-thorn, *Lycium richii* A. Gray, the bushes being thickly covered with a lichen, *Ramalina combeoides* Nyl.

Dr. Williams spent some time beating the Box-thorn bushes, and succeeded in recovering larvae of two species which were feeding on the lichen. This stimulated us to further search which resulted in additional caterpillars, and subsequently made possible the recording of the following information concerning the life histories of *Cisthene nexa* and *Agriopodes viridata*.

Cisthene nexa Bdv.

This species comes to light in great numbers at Del Mar, along with *C. faustinula* Bdv., *C. conjuncta* B. & McD., and *C. dorsimacula* Dyar. All three seem to intergrade to such a degree that it appears to indicate variation within a single species.

They occur in areas where *Ceanothus*, *Adenostoma* and *Quercus* are infested with the lichen *Parmelia trichotera* Hue. I have diligently searched the latter in past years without results, but suspect that it is the local food plant. Since the larvae are night feeders, and good examples of protective coloration, they are difficult to find.

[1]Proc. Calif. Acad. Sci. June, 1878.

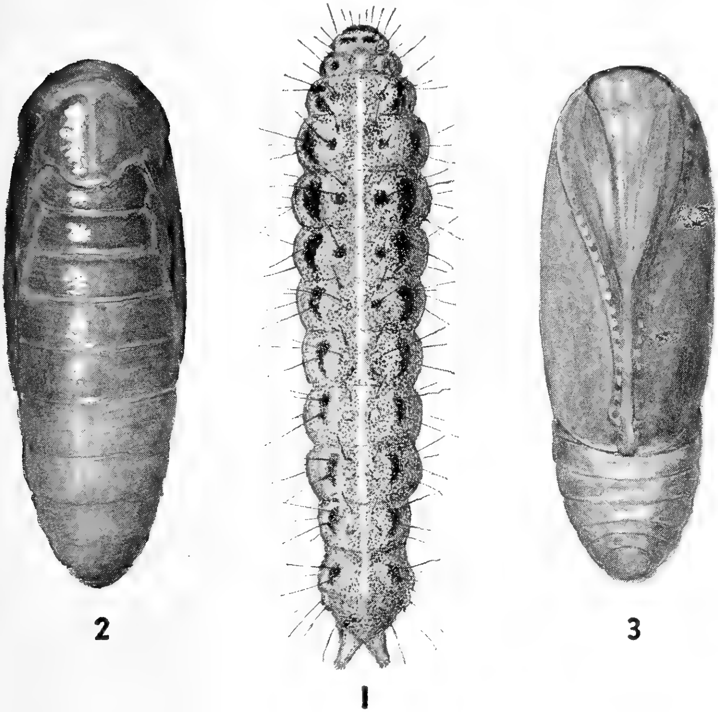

PLATE 11

Larva and pupa of *Cisthene nexa* Bdv. Fig. 1. Larva, dorsal aspect enlarged X 10. Fig. 2. Pupa, dorsal aspect, and Fig. 3. Pupa ventral aspect, enlarged X 10.
Reproduced from painting by the author.

The egg, larva and pupa were described in 1878, by Henry Edwards, as previously noted. F. X. Williams described the egg, larva and pupa of *Cisthene faustinula* in 1905[2], and gave figures of segments 1, 2, 5 and 6 of the mature larva. He listed the food plant as *Ramalina menziesii* Tuck., and expressed the opinion that *faustinula* and *nexa* were conspecific.

We were unable to secure eggs of *C. nexa,* but Henry Edwards' description (*loc. cit.*) combined with Williams' notation suffices.

The early larval instars are still unrecorded, except for the first instar of *C. faustinula* which Williams (crediting Grinnell) gives at the conclusion of his paper, herein cited.

[2]Ent. News. XVI: p. 257

No illustration of the mature larva and pupa of *nexa* occurs in the literature. A drawing has been prepared to make up for this deficiency, and is reproduced on Plate 11, fig. 1. A brief description of the mature larva and pupa is included to supplement the earlier published records.

Mature larva. — Length, 10 mm. Greatest width at fourth segment, 2.2 mm. Head; smaller than first segment, the color being yellow-green, heavily blotched with black. It is thickly covered with short yellowish hairs. The ocelli are brownish black, and the mouth parts are edged with black.

The body tapers rather acutely towards the head, and gradually towards the cauda. The ground color is yellow-green.

There is a middorsal longitudinal light band which expands at each segmental juncture, and contracts in the center of each segment.

Lateral to this band there is a row of small papillae, the anterior ones being dark and the posterior ones lighter. Each papillus bears a long black hair.

Lateral to this is a longitudinal row of relatively large warty nodules bearing one or more papillae, topped by black hairs. These nodules occur one to each segment on each side. They are placed on heavy black bases, each of which is somewhat crescentic.

Numerous small, light colored papillae occur on the infrastigmatal area, each topped with a yellow or colorless hair.

There are numerous small black dots and blotches scattered over the body, the majority being concentrated in the region of the warty tubercles.

The legs and prolegs are concolorous with the body, as are also the spiracles.

With the five examples of larvae under observation, it was noted that considerable variation in intensity of color, and length of body was present.

All spun fragile cocoons, but only four reached maturity.

Pupa. — Length, 7 to 9 mm. Greatest width, 2.5 to 2.8 mm. Elongate-oval in shape, with a regularly rounded head and cauda.

The color is a deep brown, somewhat darker on the wings, and slightly lighter on parts of the thorax. The maxillae reach to the margins of the wings, and the antennae are slightly shorter.

The cremaster is a rounded button, without hooks or spines.

A few minute hairs are barely visible on the caudal half of the pupa.

Other structural features are adequately shown on Plate 11, figs. 2 and 3.

Four imagos emerged between October 9 and 30, 1955.

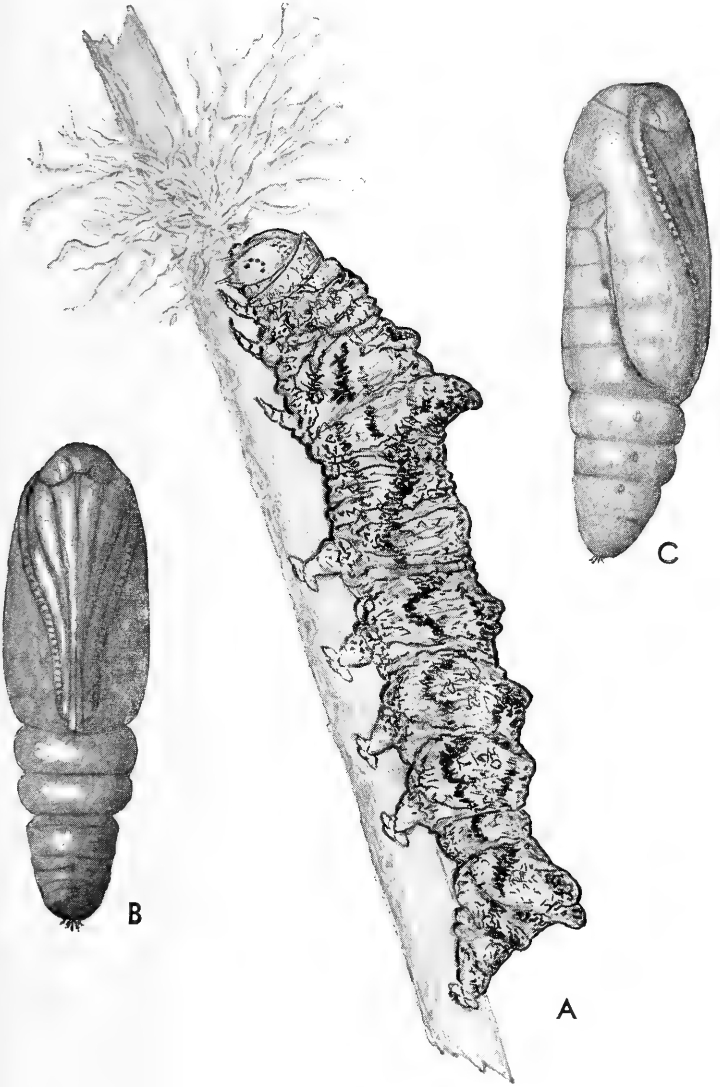

PLATE 12

Larva and pupa of *Agriopodes viridata* Harv. Fig. A. Larva, Lateral aspect, enlarged X 7½. Fig. B. Pupa, ventral aspect, and Fig. C., pupa, lateral aspect, enlarged X 8.
Reproduced from painting by the author.

AGRIOPODES VIRIDATA Harv.

The larvae of this species is so perfectly camouflaged that it is impossible of detection on the food plant. Even with the beating technique it is difficult to distinguish among the fragments of

lichen and twigs that fall on the sheet. Very few examples were taken, and only three reached maturity.

Mature larva. — Length, 18 mm. Greatest width at third segment, approximately 3 mm. In shape, it is somewhat stout, and roughly but unevenly cylindrical, tapering slightly from the fourth segment to cauda.

Head; relatively small, and held partly retracted. The color is gray-green, with numerous black dots and blotches over the crown.

The ocelli are black, and the mouth parts margined with black. The antennae are white.

Body; Ground color, mottled gray-green and wood-gray. The surface is heavily overlaid with black dots, blotches, and discontinuous sinuate lines. The body surface is roughened by numerous folds, warty prominences and papillae. The color and shape produce the effect of lichen filaments and twigs.

There is a pair of horn-like tubercles placed dorsally on the third segment. This segment is expanded laterally, and bears a number of small papillae. There are also paired papillae, dorsally placed on the seventh and eighth segments, and suggestions of them on the sixth and ninth. The eleventh segment is topped by an eminence made up of a pair of horn-like papillae, and caudad thereto, a third. These three protrusions incline toward the rear.

The pattern of the markings is difficult to describe, and is best demonstrated in the accompanying illustration, Plate 12, fig. A.

The legs and prolegs are a very light gray-green. The heavy black lateral markings obscure the small black spiracles.

Pupation occurs on the stem of the host plant among the lichens, which are bitten off by the larva and incorporated into the surface of the cocoon, thus rendering it indistinguishable from its surroundings.

Pupa. — Length, 10 mm. Greatest width, 3.5 mm. through sixth segment. It is subcylindrical in form, the caudal and cephalic ends being well rounded.

The body color is a light brown, with a yellow tinge, the semi-translucent wing cases showing more of the yellow. The caudal end shades to a dark brown. The eyes are not prominent.

The maxillae reach to the wing margin, and the tapering antennae end at a point .1 mm. short thereof.

The brown-rimmed spiracles are relatively conspicuous.

The two segments immediately caudad to the wing margins are freely movable, the remainder being fixed and immovable.

The rounded cauda gives rise to a small cluster of recurved cremasteric hooks, the tips of which are securely imbedded in the cocoon.

Other structural features of the pupa are adequately shown on Plate 12, figs. B and C.

The three imagos emerged on Oct. 31, November 10 and December 10, 1955, respectively.

I acknowledge with gratitude the help of Francis Xavier Williams in obtaining the larvae of *Cisthene nexa* and *Agriopodes viridata,* and also am indebted to Dr. Albert W. Herre of Olympia, Washington, for identification of the lichens, *Ramalina combeoides* and *Parmelia trichotera.*

TWO NEW SPECIES OF RHAGOVELIAS
(Hemiptera: Veliidae)
(HEMIPTERA:VELIIDAE)

By CARL J. DRAKE
Ames, Iowa.

The genus *Rhagovelia* Mayr is one of the two largest genera of veliid waterstriders and is represented in the western hemisphere by more than 70 described species. The present paper adds two more members to the genus, both from Brasil.

Rhagovelia accedens, new sp.

APTEROUS FORM: Moderately large, blackish with greyish brown pubescence; pronotum with a broad, rectangular, brownish orange band in front; connexiva brownish exteriorly; appendages with flavotestaceous markings as described with structures. Pronotum produced posteriorly in both sexes so as to cover approximately two-thirds of mesonotum. Length (apterous), 4.20 – 4.75.; width, 1.70 – 1.90 mm.

APTEROUS MALE: Head with usual impressed median longitudinal line and short basal markings, provided with some longer hairs in front. Antennae fuscous black with basal fourth (sometimes nearly one-half) of first segment flavous or brownish flavous, densely pubescent, with usual long hairs on first two segments, measurements – I, 85; II, 45; III, 60; IV, 52. Rostrum testaceous with terminal segment blackish, reaching a little beyond mesosternum.

Pronotum extended posteriorly so as to conceal nearly two-thirds of mesosternum, greatest width (just behind color band) nearly twice the median longitudinal length (110:60). Thorax beneath black with acetabula, coxae and trochanters flavotestaceous, some-

times tinted with brown. Coxae and trochanters without spines. Anterior femora with basal two-fifths flavous; tibiae very little widened apically, with short comb extending a little beyond apex of segment, scarcely longer than femora, 1.25 mm. long. Middle legs very long, slender, entirely black, femora slowly tapering apically 2.25 mm. long; tibiae straight, 1.75 mm. long. Hind femora considerably swollen, 1.90 mm. long, greatest thickness about one-third of total length, with base and often most of inferior surface flavous or brownish flavous, armed beneath at basal two-fifth with a long spine followed by a row of nine or ten smaller spines that rapidly decrease in size towards apex, all spines bent posteriorly, and also armed with a second row of five to seven very short spines near the anterior edge of apical half and parallel to the row of larger spines, without spines or teeth on basal two-fifths; tibiae, 1.55 mm. long, straight or feebly bowed, entirely blackish fuscous, with a short spur at apex, with the median longitudinal row of short stout, blunt, closely-set teeth tilted slightly posteriorly; second tarsal segment a little shorter than III. Male parameres distinctly sinuate rather long, narrowed apically and terminating in a narrow, curved point.

Apterous female: Slightly broader than but with color and markings as in male. Antennal measurements nearly the same as in male. Connexiva fairly wide, upright, considerably embrowned. Hind femora rather slender, armed at apical third by a fairly long spine followed by five or six shorter ones that decrease in size apically, all spines slightly bent posteriorly. Other characters very similar to those in male.

Macropterous male: Pronotum 1.80 mm. wide at humeri and 2.02 mm. long, with posterior part sharply triangular. Hemelytra 2.05 mm. long, much longer than abdomen, blackish fuscous, sparsely hairy on basal third. Total length, 5.75 mm. Winged female unknown.

Holotype (male) and allotype (female), both apterous, Parque Nacional da Serra dos Orgada Teresopolos, altitude 1,000 meters. Paratypes: 15 specimens (2 winged), taken at same time as the type.

This species is most closely allied to *R. lucida* Gould and *R. agra*, new sp., but differs from both of them by having the third antennal segment cylindrical and not flattened or compressed dorso-ventrally in either sex. The male parameres are also quite differently shaped with distal part much longer, more narrowed, and sinuate.

Rhagovelia agra, new sp.

Apterous form: Moderately large, blackish with some bluish plumbeous, especially on ventral surface; pronotum with brownish orange band subapical, about as wide as vertex of head and

divided at middle; pubescence brownish or grayish brown. Appendages with markings as described along with structures. Length, 3.80 mm.; width, 1.52 mm.

MALE: Head with usual impressed median line and basal markings, pubescence longer in front of eyes. Rostrum dark fuscous, paler beneath, extending a little beyond prosternum. Antennae moderately long, blackish fuscous, with usual long hairs on first two segments, third segment strongly flattened and compressed dorso-ventrally, measurements – I, 70; II, 35; III, 46; IV, 42.

Pronotum twice as wide as long (105:54), with posterior margin slowly evenly rounded, covering about three-fifths of mesonotum; mesonotum with exposed posterior part nearly half as long as pronotum. Abdomen slowly tapering posteriorly, connexiva more strongly narrowed on last segment. All coxae, fore and hind trochanters and bases of fore and hind femora flavous or brownish flavous. Anterior femora almost as long as tibiae; tibiae rather densely pubescent, moderately flattened beneath apically, with a short, straight, dark, apical comb. Middle legs long, slender; femora 1.75 mm. long, tibiae 1.40 mm. long; tarsal segments II and III equal in lengths each 0.90 mm. long. Hind femora 1.40 mm. long, moderately swollen, about one-fourth as thick as long, armed beneath at middle with a moderately long spine which is preceded by a row of around 14 closely-set, very short, dark teeth (from base to long spine) and then followed by a row of five or six shorter spines that rapidly decrease in size apically; tibiae straight, subequal to femora in length (1.42 mm. long), with a short spur at apex, armed beneath with a longitudinal row of 12 to 14 short teeth, all of which are tilted posteriorly and difficult to see on account of hairy vestiture. Male parameres shorter and broader apically than in *R. accedens.* Winged male and female unknown.

APTEROUS FEMALE: Slightly stouter than male, but with color and markings very similar. Hind femora slightly incrassate, without armature; tibiae also unarmed. Coxae and trochanters without spines. Connexiva moderately wide, nearly upright, with short hairs along exterior margins, with hairs more numerous behind. Third antennal segment moderately flattened and compressed dorso-ventrally. First dorsal tergite swollen and hairy.

HOLOTYPE (male) and ALLOTYPE (female) Rio de Janeiro, Brasil, 1938, C. J. Drake. PARATYPE: 1 male (damaged), taken with type.

Recognized from its congeners (species that have the pronotum covering approximately one-half of mesonotum in apterous forms of both sexes) by the shorter antennae flattened third antennal segment in both sexes, and the armature of femora and tibiae of hind legs in male and hind femora in female.

COMMANDER CHARLES MONTAGU DAMMERS
1878 – 1956

Charles M. Dammers passed away at his residence on Victoria Avenue in Riverside, California, on October 16, 1956.

For many years he was a member of the Southern California Academy of Sciences, and of our affiliated organization, the Lorquin Entomological Society.

Commander Dammers was born in Symondsbury, Dorset, England, May 3, 1878, the son of Alfred William Hounsell Dammers, and Hebe Julia Annette Templer Dammers. His grandfather, General F. Dammers was personal aide to blind King George of Hanover.

Charles Dammers had a colorful and very active career which led him into many corners of the globe. He joined the Royal Navy at the age of twelve years, on HMS Brittania, and eventually became an authority on mine sweeping, attaining the rank of Commander. After retirement from the navy he took up ranching in Argentina. His properties there embraced 27 square miles, including one of the highest mountain peaks in South America. There he raised cattle, grew oranges, and for recreation, hunted and played polo.

At the opening of World War I, he reentered the Royal Navy, and served through the conflict, being awarded the D.S.O. and the Legion of Honor. Thereafter, he and his wife, Ethel Abell Dammers came to the United States and eventually to Riverside.

The avocational interests of Charles and Ethel Dammers, in California, were many and varied. They were experts in rearing and producing new varities of pelargoniums, and at one time had 32 species of violets in their garden. They were also very active in British war relief.

Charles Dammers special interest was the study of Lepidoptera. He corresponded widely with specialists, and a number of butterflies, moths, and other insects were named for him. In association with Dr. John Adams Comstock, he published numerous papers, dealing with the life histories of Lepidoptera many of which were illustrated by his own drawings, executed with skill and fidelity.

Some time after the death of his wife, which occurred February 18, 1945, he presented his original paintings and drawings to the Los Angeles County Museum, where they now form a valued addition to the Division of Entomology.

Commander Dammers is survived by two brothers and one sister, i.e.; Captain Robert William Dammers, of Catesbury Farm, Lapworth, Warwickshire, England, – Edward Maximilian Dammers, Esq., of 28 Church Street Herriot Somerset, England, and Mrs. Beatrice Margarethe Howard, of Downe Hall, Bridport, Dorset, England. He also leaves two children in the United States, – Carlito Dammers, and Mrs. Esther Dammers Edgar.

– J.A.C.

SCIENTIFIC NOTES

CONENOSE BUG AND TRYPANOSOME OBSERVATIONS FOR 1955-56 FROM SOUTHWESTERN NATIONAL MONUMENTS

Cooperative collecting by Park Superintendents, rangers and naturalists during 1955 revealed 37 *Triatoma* from the following sources: Montezuma Castle, 1 ♂, 3 ♀ *protracta,* 1 ♂ *recurva (longipes);* Tonto, 2 ♂, 1 ♀ *protracta,* 5 ♂ *recurva,* 9 ♂, 8 ♀ *rubida uhleri;* and Tuzigoot, 2 ♂, 2 ♀ *protracta* and one 5th nymph, 1 ♂, 1 ♀ *rubida uhleri.* Additionally 1 ♂, 1 ♀ *rubida uhleri* were forwarded from Clarkdale, Arizona. The Montezuma Castle *recurva* was found on sheets in the bedroom, and the female *protracta* were collected from the living room wall, under a bed pillow, and in a covered wooden box for garbage cans between residences (G. S. C.). The Tonto specimens all came from outer residence walls (P. W.). One Tuzigoot male *protracta* was found in the Museum, the female *protracta* in the residence bathtub and the 5th instar *rubida* nymph in the residence (J. W. S.).

Examination microscopically of the feces of 22 *Triatoma* for 1955 from Montezuma Castle, Tonto and Tuzigoot revealed 1 ♂ *protracta* from Montezuma Castle, and 1 ♂, 1 ♀ *protracta* and 1 ♂, 1 ♀ *rubida uhleri* at Tuzigoot naturally infected with a trypanosome morphologically indistinguishable from *Trypanosoma cruzi* Chagas. Thus, the infection rate for these *Triatoma* was 22.7%. The male Montezuma Castle *protracta* was found in the residence screened back porch (G. S. C.). The male Tuzigoot *protracta* was found in the Museum and the female collected in the residence bathtub. The male Tuzigoot *rubida uhleri* was found in the residence and the female in the office (J. W. S., F. R. P.). Additional house invading arthropods received included 1 soldier bug, *Sinea,* 4 ♂, 1 ♀ brown assassin bugs, *Reduvius personatus,* and 1 ♂ squash bug, *Anasa tristis.*

Summer collecting for 1956 included 48 *Triatoma* as follows: 2 ♂ *protracta* from Arches; 1 ♂, 2 ♀ *protracta* from Chaco Canyon; 1 ♂, 2 ♀ *protracta* and 2 ♀ *rubida uhleri* from Montezuma Castle; 2 ♂ *protracta,* 3 ♀ *rubida uhleri* and 2 ♂ *recurva* from Montezuma Well; and 5 ♂, 2 ♀ *protracta,* 2 ♂, 6 ♀ and one 5th nymph of *rubida uhleri* from Tuzigoot. The Arches *protracta* were collected in beds (B. E. W.). The Montezuma Castle female *protracta* came from a living room and a bedroom wall while one *rubida* was taken from the residence living room wall in the evening and the other was found in a child's sock when dressing (G. S. C.). For the Montezuma Well *recurva,* G. R. Wenger reports one "landed on me at the Well just after dark", and the other was found on the outside of the residence screen door. Additional Arizona *Triatoma* included 1 ♂ *rubida uhleri* from a garage in Globe, one 5th *rubida uhleri* nymph from a mining cabin in Sycamore Canyon, and 1 ♂ *protracta,* 3 ♂ and 4 ♀ *rubida uhleri* from residences in Clarkdale. One male house invading brown assassin bug, *Reduvius personatus,* was received from Aztec Ruins. Most of these *Triatoma* were not examined for trypanosomes since equipment was unavailable. One female *protracta* reported above from Chaco Canyon and 1 ♂, two 5th, one 4th, and one 2nd instar nymphs of *Triatoma protracta woodi* collected 10 miles south of Gran Quivira, Socorro County, New Mexico were negative for trypanosomes.

This is the first report of recovery of *Triatoma* naturally infected with *Trypanosoma cruzi* from Montezuma Castle and Tuzigoot National Monuments.

The writer wishes to thank Naturalists L. P. Arnberger and Earl Jackson, Southwestern National Monuments, National Park Service, and the following contributors: Supt. B. E. Wilson, Arches; Supt. H. F. Hastings, Aztec Ruins; Supt. C. C. Sharp, Chaco Canyon; Supt. C. A Burroughs, Coronado National Memorial, Archaeol. G. S. Cattanach, Jr., Montezuma Castle; Archaeol. G. R. Wenger, Montezuma Well; Archaeol. P. Welles, Tonto; and Supt. J. W. Stratton and Archaeol. F. R. Peck, Tuzigoot. —
Sherwin F. Wood, Life Sciences Department, Los Angeles City College, Los Angeles 29, California.

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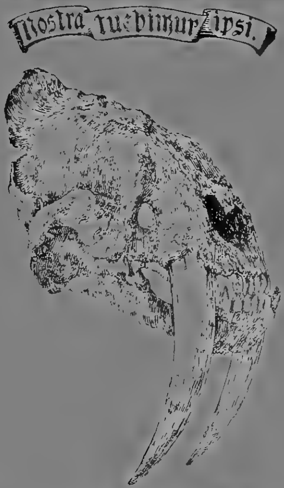

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Erratum

Referral to Plate 13, figure 14 (bottom of p. 71) should appear as follows, on p. 73:

Enaeta cumingii pedersenii Verrill

Plate 13, figure 14

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PLIOCENE AND PLEISTOCENE FOSSILS FROM THE SOUTHERN PORTION OF THE GULF OF CALIFORNIA

By LEO GEORGE HERTLEIN

INTRODUCTION AND ACKNOWLEDGMENTS

This paper is based upon collections of invertebrate fossils, chiefly mollusks, from the east coast of the southern portion of Lower California, Mexico, and from three of the islands in the Gulf of California. These fossils, of Pliocene and Pleistocene age, were assembled on two expeditions, one by Dr. Edwin H. Hammond, Department of Geography, University of California (now at the University of Wisconsin), in 1949, the other by Dr. G. D. Hanna, Department of Geology, and J. R. Slevin, Department of Herpetology, California Academy of Sciences, in 1953.

Numerous species of Pliocene and Pleistocene fossils have been cited from this general region by Hertlein (1925; 1931), Hanna & Hertlein (1927), Beal (1948), Vokes (1948; 1949; 1955), and Durham (1950). A considerable number of the species represented in the present collections, especially Pleistocene ones, have not been recorded heretofore from this region as fossils. It therefore appears desirable to list the species from the various localities, their approximate age, together with notes on a few forms of special interest. One such species of special interest is a fossil abalone whose occurrence in late Pleistocene strata in the Gulf of California is recorded here for the first time.

The present study indicates that the species represented in the collections apparently lived under the same ecologic and climatic conditions as those prevailing today in the adjacent waters of the Gulf of California. This is in complete agreement with the conclusions of Hertlein and Emerson (1956) resulting from their study of Pleistocene invertebrate fossils from the Puerto Peñasco area in northwestern Sonora near the head of the Gulf of California.

The author wishes to express his appreciation to those persons who aided in various ways during the preparation of this paper. Acknowledgments are due Dr. E. T. Hammond, Department of Geography, University of Wisconsin, for collections of fossils and

information relating thereto, which he assembled in Lower California; to Dr. G. D. Hanna, Curator of the Department of Geology, and to Mr. J. R. Slevin, Curator of the Department of Herpetology, California Academy of Sciences, for information concerning the collections obtained during their expedition to the Gulf of California on the research Motor Vessel Orca; to Dr. J. W. Durham, Department of Paleontology, University of California, for the identification of the species of corals in the collection. The photographs used for illustrations on the plate were made by Mr. Charles Crompton, California Academy of Sciences.

COLLECTIONS FROM REGION ABOUT LA PAZ

Collections from five localities in the general region about La Paz, Lower California, were assembled by Dr. Hammond (1954) during 1949 in connection with his studies of the geomorphology of the Cape region. One additional lot [Loc. 32943 (C.A.S.)] may be of very late Pleistocene age but probably is from kitchen middens. These fossils were sent to the author for identification by Dr. Hammond, who generously presented them to the California Academy of Sciences. The localities from which the fossils came, the species represented, and remarks concerning their age follow.

PLIOCENE

Locality 32946 (C.A.S.). In limy sandstone in side of calera cut in Tertiary sediments approximately 2 miles southeast of La Rivera and about 1 mile from the coast of Lower California; E. H. Hammond, collector, 1949.

Arca sp.
Ostrea heermanni Conrad
Ostrea cf. *O. palmula* Carpenter
Pecten cf. *P. modulatus* Hertlein
Turritella cf. *T. imperialis* Hanna

The specimens in this lot are not well preserved. Comparable species occur in strata at other localities in this region which Durham and Vokes considered to be of early Pliocene age.

Locality 32948 (C.A.S.). Exposure of fossiliferous shaly conglomerate in Arroyo wall 4½ miles northeast of Sierra de la Trinidad, 9 miles southeast of Santiago, Lower California; E. H. Hammond, collector, 1949.

Ostrea heermanni Conrad

A single incomplete valve appears to be referable to *Ostrea heermanni*. This species was originally described from Imperial County, California, in strata believed to be of early or middle Pliocene age. It also has been recorded from beds of Pliocene age north of Santa Rosalia and from Arroyo Santiago, opposite the town of Santiago, Lower California.

PLEISTOCENE

Locality 32942 (C.A.S.). In marine terrace sediments 28 to 30 feet above high tide. Obtained from low sea cliff on the southwest shores of Palmas Bay, ½ mile west of the school at Buena Vista, Lower California; E. H. Hammond, collector, 1949.

Locality 32944 (C.A.S.). In marine terrace cover about 30 feet above high tide. Obtained from face of sea cliff about ½ mile east of mouth of Arroyo del Coyote, 2½ miles southeast of Punta Coyote, 11 miles northeast of La Paz, Lower California; E. H. Hammond, collector, 1949.

Locality 32945 (C.A.S.). From side of stream-cut in alluvial terrace about 20 feet above sea level. Obtained about 200 feet from shore at extreme southwest corner of Bahia de la Ventana, 300 yards south of Rancho Miramar, Lower California; E. H. Hammond, collector, 1949.

	Loc. 32942	Loc. 32944	Loc. 32945
Pelecypoda			
Arca (Arca) pacifica Sowerby		x	
Arca (Larkinia) multicostata Sowerby	x	x	
Botula fusca Gmelin		x	
Cardium (Trachycardium) consors Sowerby	x	x	
Chama cf. *C. frondosa mexicana* Carpenter		x	
Chione (Chione) californiensis Broderip	x	x	x
Divaricella lucasana Dall & Ochsner		x	
Glycymeris giganteus Reeve	x	x	x
Glycymeris cf. *G. maculatus* Broderip			x
Megapitaria squalida Sowerby	x	x	
Ostrea angelica Rochebrune		x	
Ostrea sp.	x		
Pecten (Nodipecten) subnodosus intermedius Conrad		x	
Pecten (Pecten) vogdesi Arnold	x	x	
Pinctada mazatlanica Hanley	x		x
Pteria sterna Gould		x	
Gastropoda			
Architectonica nobilis Bolten (*A. granulata* Lam.)	x		
Cerithium maculosum Kiener			x
Clava gemmata Hinds	x		
Hanetia (Solenosteira) pallida Broderip & Sowerby	x		
Harpa crenata Swainson		x	
Hipponix grayanus Menke		x	
Oliva incrassata Solander		x	
Oliva spicata Bolten	x	cf.	
Olivella dama Mawe	x	x	
Polinices uber Valencinnes	x		
Pyrene major Sowerby	x		
Strombus gracilior Sowerby		x	
Strombus granulatus Swainson	x		
Terebra variegata Gray		x	
Turbo fluctuosus Wood	x	x	x
Vasum caestus Broderip	x	x	
Echinoidea			
Encope sp.	x		

The species represented in this list are all living in the Gulf of California at the present time. All but four of these also are represented in collections from the Pleistocene at Santa Inez Bay or at Carmen Island. These fossils are of Pleistocene age.

Locality 32943 (C.A.S.). Shells from ground on top of 200 foot hill immediately behind school at Buena Vista, Lower California. Shells probably on Indian occupation site and not in place; E. H. Hammond, collector, 1949.

Glycymeris giganteus Reeve
Conus brunneus Wood
Oliva cf. *O. spicata* Bolten
Turbo fluctuosus Wood (operculum)
Vertebra of fish

These species of mollusks all occur living in the Gulf of California.

COLLECTIONS FROM SANTA INEZ BAY AND FROM ISLANDS IN THE GULF OF CALIFORNIA

Collections of fossils from seven localities were assembled by G. D. Hanna and J. R. Slevin between March 28 and April 9, 1953, while members of an expedition to the Gulf of California on the research MOTOR VESSEL ORCA, owned by J. E. Sefton of San Diego, California. The localities, species represented, and remarks concerning their age follow.

PLIOCENE

Locality 34033 (C.A.S.). El Mostrador (also known as Ruffo's Ranch), west side of Ceralbo Island, Gulf of California. Fossils in hard rock on the north side of the canyon. The dip is about 20° eastward; G. D. Hanna, collector, March 22, 1953.

Pecten (Nodipecten) subnodosus intermedius Conrad
Pecten (Plagioctenium) abietis E. K. Jordan & Hertlein
Spondylus princeps Broderip
Balanus sp.

The presence of *Pecten abietis* at this locality indicates that the strata in which it was embedded are of Pliocene age.

Locality 34034 (C.A.S.). Santa Inez Bay, east coast of Lower California. From hard brownish, limy, sandy strata in low hills back of the bay which, toward the beach, are overlain by Pleistocene terrace material; G. D. Hanna and J. R. Slevin, collectors, April 9, 1953.

PELECYPODA
Ostrea cf. *O. angelica* Rochebrune
Ostrea cf. *O. heermanni* Conrad
Pecten (Chlamys) cortezianus Durham
Pecten (Euvola) keepi Arnold

Pecten (Pecten) carrizoensis Arnold
Pecten (Plagioctenium) circularis calli Hertlein
Pecten (Plagioctenium) mendenhalli Arnold

ECHINOIDEA
Agassizia scrobiculata Valenciennes

All except one of the species of pelecypods represented at this locality are extinct forms, known to occur only in strata of Pliocene age. The present assemblage appears to be of approximately the same age as that of the Imperial formation in Imperial County, California, which recent workers have considered to be of early Pliocene age.

Locality 34035 (C.A.S.). South Anchorage, San Esteban Island, Gulf of California; G. D. Hanna, collector, April 2, 1953.
Pecten (Plagioctenium) circularis Sowerby (juv.)
The preservation of the specimens as well as the field observations concerning the enclosing strata suggest Pliocene age for the fossils from this locality.

PLEISTOCENE

Fossils of Pleistocene age were collected at four localities by Dr. G. D. Hanna and J. R. Slevin while on the expedition to the Gulf of California on the ORCA. These were from Santa Inez Bay and Point El Pulpito, Lower California, and from Carmen Island in the Gulf of California. The total number of species and subspecies from the four collecting stations is 129, representing Pelecypoda (66), Scaphopoda (1), Gastropoda (56), Echinoidea (4), Anthozoa (2). The class Cirripedia is represented by one unidentified species of barnacle *(Balanus)*.

The largest number of species and subspecies (86) taken at one station was at Santa Inez Bay, a locality which has attracted the attention of other collectors. An expedition from Stanford University under the direction of W. W. Valentine and L. W. Wiedey in 1928 assembled collections at Santa Inez Bay and at Point El Pulpito, but no general report on those collections was published. William Beebe (*) visited Santa Inez Bay while on an expedition to the Gulf of California in 1936 on Templeton Crocker's yacht, ZACA, and remarked on the abundance of fossils occurring in the cliffs at that locality. A paper by Durham (1950; see also Anderson, 1950) contains the results of a study of fossils collected in the Gulf of California during a cruise on the E. W. SCRIPPS during 1940, also a discussion of the geologic features noticed at various localities. Species were cited by Durham from some of the same (or nearby) localities mentioned in the present paper.

(*) Beebe, W. Zaca Venture (under the auspices of the New York Zoological Society. Harcourt, Brace & Co.: New York), pp. 109-110, 1938.

The localities and list of species collected by Hanna and Slevin follow.

Locality 34036 (C.A.S.). Point El Pulpito, east coast of Lower California. Top layer of fossiliferous beds exposed in arroyo about 1 mile northwest of the coast; G. D. Hanna and J. R. Slevin, collectors, March 31, 1953.

Locality 34163 (C.A.S.). Santa Inez Bay, east coast of Lower California. Pleistocene elevated beach extending inland about ¾ mile. The section is about 6 (or more) feet in thickness, overlying brown, limy beds of Pliocene age; G. D. Hanna and J. R. Slevin, collectors, April 9, 1953.

Locality 34164 (C.A.S.). Point El Pulpito, east coast of Lower California. Fossils from strata lower in the section than those mentioned for Locality 34036 (C.A.S.); G. D. Hanna and J. R. Slevin, collectors, March 31, 1953.

Locality 34165 (C.A.S.). Coral reef exposed at the south end of Puerto Ballandra, Carmen Island, Gulf of California. This occurs from sea level to an elevation of about 50 feet; G. D. Hanna and J. R. Slevin, collectors, March 28, 1953.

	Sta.	El Pulpito		Carmen Id.
	Inez	Uppermost	Lower	
	34163	34036	34164	34165
Pelecypoda				
Anatina (Raëta) undulata Gould	x			
Anomalocardia subimbricata tumens Verrill	x	x	x	x
Antigona (Periglypta) multicostata Sowerby	x			x
Apolymetis cognata Pilsbry & Vanatta	x			
Arca (Acar) gradata Broderip & Sowerby	x			
Arca (Arca) pacifica Sowerby			x	
Arca (Barbatia) reeveana d'Orbigny				x
Arca (Larkinia) multicostata Sowerby			x	x
Botula fusca Gmelin *(Mytilus cinnamomenus* Chemnitz) (fragment)				x
Cardita affinis C. B. Adams	x			
Cardita megastropha Gray			x	
Cardium (Americardium) biangulatum Broderip & Sowerby	x		x	x
Cardium (Laevicardium) elatum Sowerby			x	x
Cardium (Laevicardium) elenense apicinum Carpenter	x			
Cardium (Mexicardium) procerum Sowerby	x			
Cardium (Trachycardium) consors Sowerby	x		x	
Chama frondosa Broderip			x	
Chama frondosa mexicana Carpenter				x
Chama squamuligera Pilsbry & Lowe	x			x
Chione (Chione) californiensis Broderip			x	
Chione (Chione) undatella Sowerby	x			x
Chione (Chionopsis) gnidia Broderip & Sowerby	x			
Codakia distinguenda Tryon	x			x

	Sta. Inez 34163	El Pulpito Uppermost 34036	El Pulpito Lower 34164	Carmen Id. 34165
Corbula bicarinata Sowerby	x			x
Crassatellites (Hybolophus) digueti Lamy			x	
Ctena mexicana Dall	x			x
Diplodonta inezana Hertlein & Strong	x			
Diplodonta subquadrata Carpenter				x
Divaricella lucasana Dall & Ochsner	x		x	
Dosinia (Dosinia) ponderosa Gray	x	x	x	
Glycymeris (Axinactis) delessertii Reeve	x			
Glycymeris giganteus Reeve		x	x	x
Glycymeris maculatus Broderip			x	
Glycymeris multicostatus Sowerby	x			x
Isognomon janus Carpenter				x
Lithophaga attenuata Deshayes	x			
Lucina (Cavalinga) lampra Dall			x	
Lucina (Cavalinga) cf. *L. (C.) lingualis* Carpenter	x	x		
Mactra nasuta Gould	x			
Megapitaria aurantiaca Sowerby	x			
Megapitaria squalida Sowerby	x		x	x
Miltha xantusi Dall			x	
Modiolus capax Conrad	x			
Ostrea angelica Rochebrune	x			x
Ostrea cf. *O. corteziana* Hertlein	x			
Ostrea fisheri Dall				x
Ostrea megodon Hanley			x	
Pecten (Nodipecten) subnodosus intermedius Conrad			x	x
Pecten (Pecten) vogdesi Arnold			x	x
Pecten (Plagioctenium) circularis Sowerby	x		x	x
Pinctada mazatlanica Hanley	x			x
Plicatula cf. *P. inezana* Durham				x
Pseudochama saavedrai Hertlein & Strong		x		
Semele corrugata californica A. Adams				x
Semele flavescens Gould	x			x
Septifer zeteki Hertlein & Strong				x
Solecardia eburnea Conrad	x			
Spondylus princeps Broderip			x	x
Tagelus (Tagelus) affinis C. B. Adams	x			
Tagelus (Tagelus) californianus Conrad	x			
Tellina (Eurytellina) simulans C. B. Adams	x			
Tellina (Merisca) meropsis Dall				x
Tellina (Scrobiculina) ochracea Carpenter	x			
Tellina (Tellinella) cumingii Hanley	x			
Thracia curta Conrad	x			
Tivela byronensis Gray	x	x		
SCAPHOPODA				
Dentalium inversum Deshayes	x			
GASTROPODA				
Acanthina muricata tuberculata Gray in Sowerby	x			x
Acmaea atrata Carpenter		x		
Architectonica nobilis Bolten	x	x		

	34163 Inez Sta.	34036 Uppermost El Pulpito	34164 Lower El Pulpito	34165 Carmen Id.
Bulla punctulata A. Adams	x			
Cassis (Levenia) coarctata Sowerby			x	
Cerithidea cf. *C. mazatlanica albonodosa* Carpenter	x			x
Cerithium maculosum Kiener	x	x		x
Cerithium uncinatum Gmelin	x			
Clava gemmata Hinds	x	x	x	x
Conus princeps Linnaeus	x			
Conus purpurascens Broderip	x	x	x	
Conus regularis Sowerby	x	x		
Conus scalaris Valenciennes	x			
Conus ximines Gray	x	x		
Crucibulum scutellatum Wood		x	x	
Crucibulum umbrellum Deshayes	x			
Cypraea albuginosa Gray	x			
Cypraea annettae Dall				x
Diodora alta C. B. Adams				x
Diodora inaequalis Sowerby				x
Enaeta cumingii pedersenii Verrill	x			
Fusinus ambustus Gould	x			
Haliotis cf. *H. fulgens* Philippi			x	
Hanetia (Solenosteira) pallida Broderip & Sowerby	x	x	cf.	
Heliacus robertsae Durham				x
Hipponix antiquata serrata Carpenter	x			x
Knefastia funiculata Valenciennes	x	x	x	
Liocerithium sculptum Sowerby	x			
Mitra sulcata funiculata Reeve	x			
Murex erythrostomus Swainson	x			
Muricopsis squamulatus Carpenter	x			x
Nassarius tiarulus Kiener	x			
Natica sp.			x	
Oliva incrassata Solander	x			
Oliva spicata Bolten	x	x	x	x
Oliva cf. *O. spicata polpasta* Duclos	x			
Olivella dama Mawe	x	x	x	x
Olivella gracilis Broderip & Sowerby	x			
Polinices bifasciatus Gray	x	cf.		
Polinices reclusianus Deshayes	x			
Polinices uber Valenciennes	x			
Pyrene fuscata Sowerby		x	x	x
Strombus galeatus Swainson			x	x
Strombus gracilior Sowerby	x		x	
Strombus granulatus Swainson		x		x
Tegula mariana Dall			x	x
Terebra strigata Sowerby	x			
Terebra variegata Gray	x	x	x	
Thais haemastoma biserialis Blainville		x		
Trivia solandri Gray	cf.	x		cf.
Turbo fluctuosus Wood		x	x	x
Turbo squamiger Reeve	x	x		
Turricula maculosa Sowerby	x			
Turritella gonostoma Valenciennes	x	x	x	x
Turritella nodulosa King	x			
Vasum caestus Broderip	x		x	
Vermetus cf. *V. centiquadrus* Valenciennes				x

	34163 Inez Sta.	34036 Uppermost	34164 Lower El Pupito	34165 Carmen Id.
ECHINOIDEA				
Clypeaster speciosus Verrill	x		x	
Encope californica Verrill	x		x	
Encope grandis inezana Durham	x		x	
Eucidaris thouarsii Valenciennes (spines)			x	x
ANTHOZOA				
Porites californica Verrill	x		x	x
Porites nodulosa Verrill				x
CIRRIPEDIA				
Balanus sp.			x	x

Only one species and one subspecies in the preceding list are, so far as known, extinct. These are: an echinoid, *Encope grandis inezana* Durham at Santa Inez Bay, and a gastropod, *Heliacus? robertsae* Durham, at Carmen Island. One pelecypod, *Plicatula* cf. *P. inezana* Durham, from Carmen Island, is represented in the Recent fauna of the Gulf by an identical or a very similar form. All the remainder of the species except one, *Haliotis* cf. *H. fulgens* Philippi, are now living in adjacent waters or in other portions of the Gulf of California and that species of abalone is known to occur at Cape San Lucas.

The very few extinct forms, 1 of 86 at Santa Inez Bay and 1, or possibly 2, of 54 at Carmen Island, are indicative of late Pleistocene age for these assemblages. This age is substantiated by their geologic occurrence in low cliffs of loosely consolidated sediments and as terrace deposits adjacent to the shore. The species represented as well as the sediment in which they occur suggest that they were deposited in warm, shallow water under conditions similar to those adjacent to the localities at the present time.

A short list of species and subspecies cited by Vokes (1948; 1949; 1955) from the Santa Rosalia formation of Pleistocene age, in the Santa Rosalia area, contains among others only five or six forms not represented in the present list. At least 75 species in the present list also occur in the Pleistocene deposits at Magdalena Bay, Lower California.

NOTES AND DESCRIPTIONS OF SPECIES

Class Pelecypoda

Ostrea fisheri Dall

Ostrea jacobaea Rochebrune, Bull. Mus. Nat. Hist. Nat. Paris, Vol. 1, No. 6, p. 241, 1895. "Îles de la Baie de la Paz." – Contreras, An. Inst. de Biologia, Vol. 3, No. 3, p. 210, figs. 22, 23, 1932. Islands of San José and Espíritu Santo, Gulf of California.

Not *Ostrea jacobaea* Linnaeus, 1758.

Ostrea fisheri Dall, Nautilus, Vol. 28, No. 1, May, 1914. "Gulf of California." New name for *Ostrea jacobaea* Rochebrune, not

O. jacobaea Linnaeus. – Lamy, Journ. de Conchyl., Vol. 73, No. 4, p. 239, 1930. Gulf of California. – Hertlein & Strong, Zoologica, New York Zool. Soc., Vol. 31, Pt. 2, p. 54, 1946. Gulf of California to the Galapagos Islands.

Ostrea fischeri Dall, Durham, Geol. Soc. America, Mem. 43, Pt. 2, p. 59, pl. 6, figs. 1, 4, 1950. Various localities in the Gulf of California from early Pliocene to Recent.

Type Locality: Of *Ostrea jacobaea*, Islands in the Bay of La Paz. Of *O. fisheri*, Gulf of California.

Range: Pliocene to Recent. Recent from San Luis Gonzaga Bay, Gulf of California, to Atacames, Ecuador, and the Galapagos Islands.

Several valves of this species are present in the collection from the coral reef in Ballandra Bay, Carmen Island. The largest specimen measures approximately 200 mm. in length from beak to base.

This species has been cited in literature dealing with oysters in the Gulf of California under various names, including *Ostrea jacobaea* Rochebrune, *O. sinensis* Gmelin, *O. sinensis* var. *cumingiana* Dunker, *O. turbinata* Lamarck, and *O. hyotis* Linnaeus, as well as *O. fisheri* Dall.

Apparently Ranson[1], who has devoted considerable time to the study of Recent oysters, considers this species to be identical with the western Pacific *Ostrea hyotis* Linnaeus. However, until this identity is definitely established, it appears best to retain the name *O. fisheri* for the eastern Pacific form. The resemblance of *Ostrea fisheri* to the Floridan *O. thomasi* McLean was pointed out by Hertlein & Strong. According to Abbott[2], that Floridan species also is considered by Ranson to be identical with *O. hyotis.*

The description and illustration of *Ostraea solida* Sowerby lead me to think that this may be an earlier name for the shell named *O. fisheri* by Dall. (See Conch. Icon., Vol. 18, *Ostraea*, sp. 28, pl. 14, fig. 28, February, 1871. "Hab. Gulf of Panama.").

Spondylus princeps Broderip

Spondylus princeps Broderip, Proc. Zool. Soc. London, May 17, 1833, p. 4. "Hab. ad Insulam Platam Columbiae Occidentalis." "Found attached to coral rocks at the depth of seventeen fathoms." – Reeve, Conch. Icon., Vol. 9, *Spondylus*, sp. 9, pl. 2, fig. 9, 1856. Original locality cited. – Hertlein & Strong, Zoologica, New York Zool. Soc., Vol. 31, Pt. 2, p. 62, 1946.

Spondylus pictorum Schreiber, Abbott, Amer. Seashells (Van Nostrand Co.: New York), p. 370, pl. 36, fig. a (four figs.), 1954. Gulf of California to Panama.

Type Locality: Island of La Plata, Ecuador, in 17 fathoms, attached to coral rocks.

Range: Pliocene to Recent. Recent, from Scammon Lagoon, Lower California, to Punta Colorado near Guaymas in the Gulf of California and south to Negritos, Peru.

Some of the earlier names applied to this species were discussed by Hertlein & Strong in 1946. Abbott recently cited it under the name of *Spondylus pictorum* Schreiber[3]. This appropriate name also was applied to this beautiful species by Chemnitz. Unfortunately, there is doubt as to whether or not the work by Schreiber is nomenclatorially valid, as pointed out by Cox[4]. The specific name applied to the species by Broderip is applicable at least until there is definite agreement concerning the validity of the names applied by Schreiber.

Durham (1950, p. 68, pl. 15, fig. 3) recently referred certain fossil specimens from the Pliocene of Carmen Island and Pleistocene of Coronado Island in the Gulf of California to *Spondylus victoriae* Sowerby. There is variation in a series of specimens of *S. princeps,* and it appears that the fossils illustrated by Durham fall within the variation of this species. In any case, the name *Spondylus victoriae* does not seem applicable to a west American species because E. A. Smith[5], who presumably had available Sowerby's type specimen, stated: "The description given of this species by Sowerby is very insufficient, and his locality, 'Gulf of California', incorrect." Smith cited it from New Caledonia and from Flinders and Clairmont Islands, northeast Australia, as well as from Port Molle and Port Nicol, Australia. Fulton[6] also cited it from the two island localities.

The great variability shown by a series of specimens of *Spondylus,* especially if imperfectly preserved fossils, was mentioned by Palmer[7], who pointed out that Dall placed more than 20 specifically named forms in the synonymy of the Recent east American *Spondylus americanus* Hermann.

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[1]See Min. Conch. Club South. Calif., No. 99, p. 9, April, 1950. See also Ranson, Bull. Mus. Nat. d'Hist. Nat. (Paris), Ser. 2, Tom. 13, No. 2, pp. 91-92, February, 1941.

[2]Abbott, R. T. American Seashells (D. Van Nostrand Co., Inc.: New York), p. 374, 1954.

[3]*Spondylus pictorum* Schreiber, Versuch einer vollstaendigen Conchylienkenntnis, nach Linnes System, Th. 2, p. 158, 1793. References to Martini, Conchyl. Cab., Bd. 7, Tab. 69, figs. E, F.; Knorr, Vergnüg., Th. 6, Tab. 12, fig. 3; Schröter, Einleit Conchyl., Th. 3, p. 213, nr. 16, Tab. 8, figs. 14, 15.

[4]Cox, L. R., Proc. Malacol. Soc. London, Vol. 18, Pt. 5, pp. 251-254, 1929.

[5]Smith, E. A. Report Zool. Coll. Indo-Pacific Ocean during voy. "Alert", 1881-2, Moll., p. 114, 1884. (Publ. Brit. Mus. Nat. Hist.).

[6]Fulton, H., Jour. Conch., Vol. 14, No. 11, p. 335, 1915.

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Apolymetis cognata Pilsbry & Vanatta

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Apolymetis cognata Pilsbry & Vanatta, Hertlein & Strong, Zoologica, New York Zool. Soc., Vol. 34, Pt. 2, p. 93, 1949. Magdalena Bay, Lower California, to Paita, Peru. – Hertlein & Strong, Essays in the Natural Sciences in honor of Captain Allan Hancock on the occasion of his birthday July 26, 1955 (Univ. South. Calif.: Los Angeles), p. 123, pl. A, figs. 14, 15, 16, November 8, 1955. Albemarle Island, Galapagos Islands.

Apolymetis clarki Durham, Geol. Soc. Amer. Mem. 43, Pt. 2, p. 90, pl. 24, fig. 12, pl. 25, fig. 14, August 10, 1950. "(loc. A3582)" ("Pleistocene, Santa Inez Bay, Lower California. From 20-foot terrace level extending from loc. A3581 to beach.").

Type Locality: Tagus Cove, Albemarle Island, Galapagos Islands.

Range: Pliocene to Recent. Recent from Magdalena Bay, Lower California, to Punta Peñasco in the Gulf of California and south to Paita, Peru, and the Galapagos Islands.

A discussion of this species was given by Hertlein & Strong in a paper published in 1949. Later Durham described a species from the Pleistocene of Santa Inez Bay under the name of *Apolymetis clarki.* There appear to be no constant characters present by which shells of that species differ from *A. cognata,* and it accordingly is here placed in the synonymy of the latter species.

Class Gastropoda
Haliotis cf. H. fulgens Philippi
Plate 1, figure 13

Haliotis fulgens Philippi, Zeitschr. f. Malakozool., Jahrg. 2, p. 150, 1845. "Patria." – Philippi, Abbild. u. Beschreib. Conchyl., Bd. 2, Heft 8, p. 219(11), Tab. 7, fig. la, Tab. 8, fig. 1, April, 1847. "Patria: California?" – I. S. Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci., Vol. 2, Pt. 3, p. 233, pl. 89, fig. 1, pl. 90, fig. 1, 1927. "Monterey Bay, California, to Lower California." [See corrections of plates by Keen, Checklist of West North Amer. Moll. (Stanford Univ. Press), p. 83, 1937]. – Bonnot, Calif. Fish & Game, Vol. 34, No. 4, p. 152, fig. 60, 1948. "Farallon Islands to Gulf of California."

Haliotis splendens Reeve, Conch. Icon., Vol. 3, *Haliotis*, sp. 9, pl. 3, fig. 9, April, 1846. "Hab. California."

Haliotis planilirata Reeve, Conch. Icon., Vol. 3, *Haliotis*, sp. 62, pl. 16, fig. 62, July, 1846. "Hab. — ?"

Type Locality: No locality cited originally. "Patria: California?" (Philippi, 1847).

Range: Pliocene to Recent. Recent, from Farallon Islands, California, to Cape San Lucas, Lower California.

An imperfect specimen in the collection from the lower beds at Point El Pulpito appears to be referable to *Haliotis fulgens* Philippi. The shell of this specimen is thinner than is usual for this form. This species is known to occur in Pliocene and Pleistocene deposits on the west coast of Lower California, but this is the first specimen recorded with certainty as a fossil from the Gulf of California. It is known to live at Cape San Lucas, Lower California, but no specimens of it have been found in the Gulf of California by collectors on any expeditions of the California Academy of Sciences.

Nassarius tiarulus Kiener

Buccinum tiarula Kiener, Spéc. Gén. et Icon. Coq. Viv., Purpurifères, Pt. 2, *Buccinum*, p. 111, pl. 30, fig. 4 (two figs.), 1841. "Habite la mer des Indes sur les côtes de Madagascar."

Nassa tiarula Kiener, Reeve, Conch. Icon., Vol. 8, *Nassa*, species 92, pl. 14, figs. 92a, 92b, December, 1853. "Hab. Madagascar." — Tryon, Man. Conch., Vol. 4, pl. 12, figs. 174 and 175 (only), 1882.

Nassarius tegula tiarula Kiener, Demond, Pac. Sci. (Univ. Hawaii), Vol. 6, No. 4, p. 307, pl. 1, fig. 4, 1952. "Puerto Escondido, Gulf of California". Recent.

Type Locality: Madagascar originally cited, but this is believed to be erroneous. Typical specimens occur at Escondido Bay, Gulf of California.

Range: Pliocene to Recent. Recent, from Punta Peñasco in the Gulf of California to Panama.

Description: Shell of moderate size, spire acuminate, whorls subangulate at the periphery where they are coronated with a row of nodes which are especially strong on the last whorl; the nodes often extend toward the base as weak axial ribs, but the 2 or 3 ribs preceding the varicose outer lip are usually obsolete. The entire shell bears subobsolete spiral striae; color yellowish-white with brown spots between the nodes, especially on the later portion of the last whorl, sometimes with slaty-ash bands; callus white. Commonly 15-18 mm. in length and 8-10 mm. in diameter.

This species was originally cited from Madagascar by Kiener. Later Reeve also cited it from the same locality, but according to Carpenter[8], this assignment was without authority. Carpenter

[8]Carpenter, P. P., Cat. Mazatlan Shells, p. 496 (footnote), March, 1857.

considered it to be a synonym of Reeve's *Nassa tegula*, although Kiener's species was named much earlier. Pease[9], after studying west American specimens, also concluded that Kiener's species was a variety of *N. tegula* Reeve and that the original locality, Madagascar was probably an error. Tryon, however, considered *N. tiarula* to be an inhabitant of the western Pacific. More recently, Dautzenberg[10] cited it as occurring in the fauna of Madagascar, but he mentioned no localities other than the citations from the literature by Kiener, Reeve, and von Martens. However, he did cite several localities from Madagascar for the similar *Nassa coronula* A. Adams[11], a species erroneously cited from west American waters by Pilsbry & Lowe[12]. Schepman[13], in his discussion of *Nassa delicata* A. Adams from the East Indies, stated that he considered this species to be distinct from *N. tiarula* and not identical, as indicated by Tryon. According to Tomlin[14], *N. delicata* is identical with *N. callosa* A. Adams, which was originally described from the Philippine Islands ("Hab. Bais, island of Negros, 7 fathoms, sandy mud (H.C.). Mus. Cuming."). A consideration of the foregoing facts leads the author, at least for the present, to retain the name *Nassarius tiarulus* for west American shells.

Nassarius tegulus[15] Reeve also was originally described without information as to the locality from which it came. As mentioned by Dall[16], it appears to be a similar but generally more northern, darker form of *N. tiarulus*. It is said to range from Alamitos Bay, California, to Scammon Lagoon, Lower California, and perhaps to Magdalena Bay.

The shell described by Carpenter under the name of "*Nassa ?tegula*, var. *nodulifera*, Phil.[17]" is apparently a form of *N. tiarulus* with strong axial and spiral sculpture. Judging from Reeve's

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[9]Pease, W. H., Amer. Jour. Conch., Vol. 5, Pt. 2, p. 83, October 7, 1869.

[10]Dautzenberg, P., Faune des Colonies Francaises, Vol. 3, Fasc. 4, p. 411, 1929. See also J. Giner Marí, Journ. de Conchyl., Vol. 78, No. 1, p. 12, 1934.

[11]*Nassa coronula* A. Adams, Proc. Zool. Soc. London for 1851, p. 96, issued December 7, 1852. "Hab. Corrigidor, Bay of Manila, under stones, low water (H.C.). Mus. Cuming." — Reeve, Conch. Icon., Vol. 8, *Nassa*, species 99, pl. 15, figs. 99a, 99b, 1853.

[12]Pilsbry, H. A., and Lowe, H. N., Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, p. 115, 1932 (as *Nassa coronula* C. B. Adams).

[13]Schepman, M. M., Siboga Exped., Monogr. 49d, p. 322, 1911.

[14]Tomlin, J. R. leB., Proc. Malacol. Soc. London, Vol. 20, pt. 1, p. 42, 1932.

[15]*Nassa tegula* Reeve, Conch. Icon., Vol. 8, *Nassa*, species 98, pl. 15, fig. 98, December, 1853. "Hab. — ?"

[16]Dall, W. H., Proc. U. S. Nat. Mus., Vol. 51, No. 2166, p. 577, 1917.

[17]"*Nassa ?tegula*, var. *nodulifera*, Phil.", Carpenter, Cat. Mazatlan Shells, p. 496, March, 1857. "Hab. — Mazatlan; extremely rare; L'pool Col."

illustration, I am uncertain whether or not the shell described by C. B. Adams[18] from Panama as *Nassa glauca* is identical with *N. tiarulus* or whether it is sufficiently distinct to merit subspecific status. Hidalgo[19] considered it to be distinct from *N. tegulus* but he did not mention *N. tiarulus*.

Specimens of *Nassarius tiarulus* were dredged by Beebe & Crocker in Santa Inez Bay in the Gulf of California in 10-18 fathoms. It is sometimes found on mud flats. Specimens from San Ignacio Lagoon on the west coast of Lower California appear to be intermediate between *Nassarius tiarulus* and *N. tegulus* and might be referable to either. *Nassarius tiarulus* also has been recorded as occurring in the Pleistocene at Magdalena Bay, Lower California.

Genus Enaeta H. & A. Adams

Enaeta H. & A. Adams, Gen. Rec. Moll., Vol. 1, p. 167, 1858. Original list of species. "*Cumingii, Brod.*", "*cylleniformis* Sow.", "*Guildingii,* Sow.", "*guttata,* Reeve", "*harpa,* Barnes." [No type cited]. Also Vol. 2, p. 618, 1858.—Tate in Woodward's Man. Moll., Ap., p. 16, 1868. As synonyms of *Lyria* Gray he cited, "*Harpella,* Gray; *Enaeta,* Gray." "Types, *L. deliciosa,* Montf.; *L. harpa,* Barnes."—Cossmann, Essais de Paleo. Comp., Vol. 3, p. 105, 1899. "Type: *V. harpa* Barnes."—Dall, Smithson. Miscell. Coll. (Quart. Issue, Vol. 3), Vol. 48, No. 1663, p. 351, 1907 – Pilsbry & Olsson, Bull Amer. Paleo., Vol. 35, No. 152, p. 294(24), 1954.

Type (virtually designated by Tate, 1868, definitely by Cossmann, 1899): *Voluta harpa* Barnes.

The genus *Enaeta* differs from *Lyria* Gray chiefly in the thickened outer lip which is inflected and bears an obtuse tooth upon the middle of the inner margin.

This genus is known to occur from Miocene to Recent in the east American region, but only from Pleistocene to Recent in the eastern Pacific where two species and one subspecies live at the present time.

Key to west American species of *Enaeta*

A. Shoulder subangulate; ribs with strong nodes on shoulder
  a. Spire moderately high .... *cumingii*
  aa. Spire high and acute; shell more slender .... (subspecies) *pedersenii*
B. Shoulder rounded; ribs without nodes or only slightly noded; ribs more numerous; spire lower .... *barnesii*

PLATE 13, FIGURE 14

[18] *Nassa glauca* C. B. Adams, Ann. Lyceum Nat. Hist. New York, Vol. 5, pp. 285, June, 1852, 529, July, 1852, (separate, pp. 61, 305). "Habitat. — Taboga." — Reeve, Conch. Icon., Vol. 8, *Nassa,* species 139, pl. 21, figs. 139a, 139b, December, 1853. "Hab. Taboga, Panama."

[19] Hidalgo, J. G., Mem. R. Acad. Sci. Fis. Nat., Madrid, Vol. 19, p. 347, 1893.

Enaeta cumingii pedersenii Verrill

Enaeta Pedersenii Verrill, Amer. Jour. Sci. and Arts, Vol. 49, No. 146, p. 226, March, 1870. "La Paz, – J. Pedersen. Five specimens." – Dall, Smithson. Miscell. Coll. (Quart. Issue, Vol. 3), Vol. 48, No. 1663, p. 352, 1907. – M. Smith, A Review of the Volutidae (Trop. Photogr. Labor., Lantana, Florida), p. 13, 1942.

Enaeta cumingii Broderip, Durham, Geol. Soc. America Mem. 43, p. 104, pl. 32, fig. 5, August 10, 1950. Not *Voluta (Enaeta) cumingii* Broderip.

Type Locality: La Paz, Lower California.

Range: Pleistocene to Recent. Known Recent only from the type locality.

The diagnostic characters separating this species from *Enaeta cumingii* were enumerated by Verrill as follows: "This species is closely allied to the next *[Lyria (Enaeta) cumingii]*, but is more slender, with the spire more acute, smaller tubercles and costae, a more prolonged and recurved siphon, and more contracted aperture. The surface is not smooth and the color is lighter."

A single specimen in the present collection from Carmen Island still retains traces of the color markings and although the outer lip is imperfect, it apparently differs from *E. cumingii* in the characteristics mentioned by Verrill for *E. pedersenii.* The relationship, however, appears to be so close that I am inclined to retain Verrill's form as a subspecies of *E. cumingii.*

Durham illustrated a specimen from the Pleistocene of Coronado Island in the Gulf of California under the name of *Enaeta cumingii,* but he noted that it differed from that species in the more slender form and higher spire. The specimen illustrated by him appears to be referable to the form described by Verrill.

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EXPLANATION OF FIGURES ON PLATE 13

Fig. 1. *Solecardia eburnea* Conrad. Hypotype No. 10295 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 34163 (C.A.S.), Santa Inez Bay, Lower California, Mexico, Pleistocene. Length, 23.8 mm.; height, 16 mm. View of exterior of left valve.

Fig. 2. *Solecardia eburnea* Conrad. View of exterior of right valve of specimen shown in Fig. 1.

Fig. 3. *Solecardia eburnea* Conrad. View of interior of specimen shown in Fig. 1.

Fig. 4. *Solecardia eburnea* Conrad. View of interior of specimen shown in Fig. 2.

Fig. 5. *Botula fusca* Gmelin. Hypotype No. 10296 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 32944 (C.A.S.), from Arroyo del Coyote, 11 miles northeast of La Paz, Lower California, Mexico; Pleistocene. Length, 19.5 mm.; height, 10 mm. View of exterior of right valve.

Fig. 6. *Botula fusca* Gmelin. View of exterior of left valve of specimen shown in Fig. 5.

Fig. 7. *Thracia curta* Conrad. Hypotype No. 10297 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from the same locality as the specimen shown in Fig. 1. Length, 30 mm.; height, 21.5 mm. View of exterior of a somewhat misshapen right valve.

Fig. 8. *Thracia curta* Conrad. View of interior of left valve of specimen shown in Fig. 7.

Fig. 9. *Mitra sulcata funiculata* Reeve. Hypotype No. 10299 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from the same locality as the specimen shown in Fig. 1. Length, 25.8 mm.; maximum diameter, 10 mm.

Fig. 10. *Ctena mexicana* Dall. Hypotype No. 10298 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from the same locality as the specimen shown in Fig. 1. Length, 15.8 mm.; height, 16 mm. View of interior of left valve.

Fig. 11. *Ctena mexicana* Dall. View of exterior of specimen shown in Fig. 10.

Fig. 12. *Turricula maculosa* Sowerby. Hypotype No. 10302 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from the same locality as the specimen shown in Fig. 1. Length, 42.4 mm.; maximum diameter, 13.1 mm.

Fig. 13. *Haliotis* cf. *H. fulgens* Philippi. Hypotype No. 10301 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 34164 (C.A.S.), Point El Pulpito, east coast of Lower California, Mexico; Pleistocene. View of exterior of an incomplete specimen, length approximately 54 mm.; height, approximately 78 mm.

Fig. 14. *Enaeta cumingii pedersenii* Verrill. Hypotype No. 10300 (Calif. Acad. Sci. Dept. Geol. Type Coll.), fossil coral reef at Puerto Ballandra, Carmen Island, Mexico, in the Gulf of California; Pleistocene. Length, 25.3 mm.; maximum diameter, 13.2 mm.

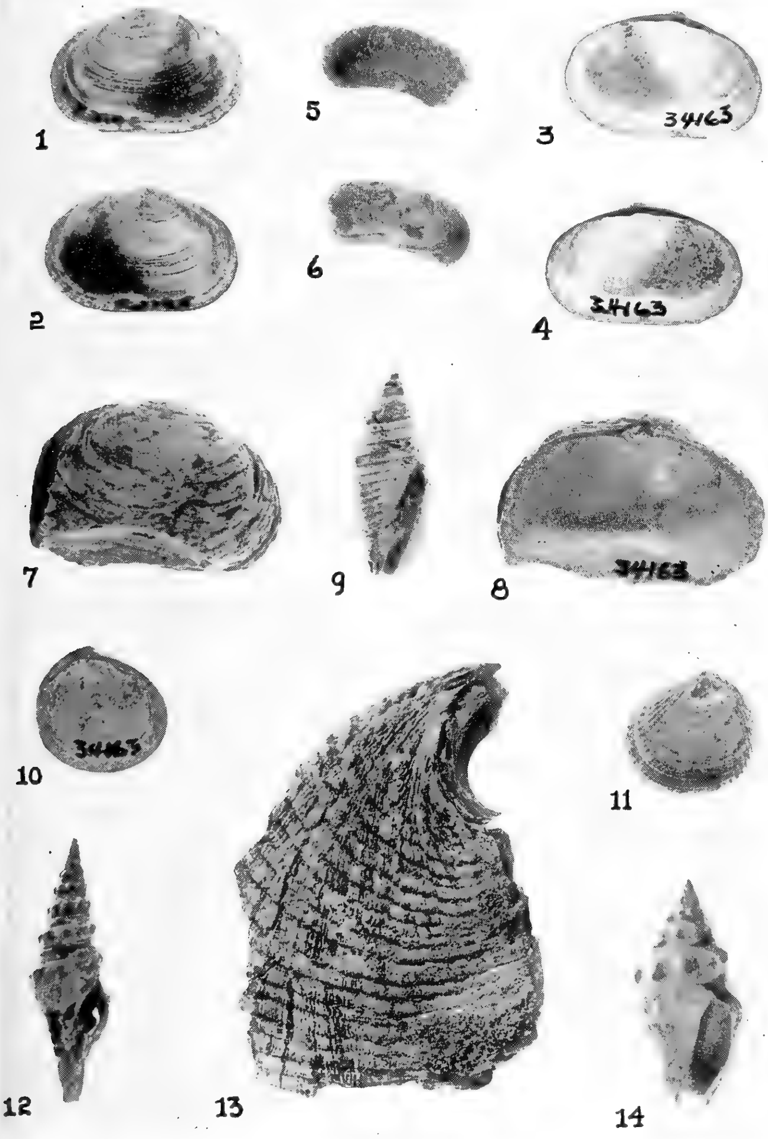

PLATE 13

MICRARIONTA (MOLLUSCA: PULMONATA) FROM NORTHWESTERN SONORA MÉXICO

By Robert J. Drake

Department of Zoology, University of Arizona

Species of the helminthoglyptoid genus *Micrarionta* are found in northern Baja California, southern California and on adjacent islands, and in southwestern Arizona; about 50 forms have been described. It has long been known that at least one form (*Micrarionta rowelli mexicana*) occurs in northwestern Sonora, México; however, this form was apparently never illustrated and type material at the time of its description was perhaps in two collections – the holotype (and paratypes?) at the Academy of Natural Sciences of Philadelphia and paratypes in the collection of Herbert Nelson Lowe, then of Long Beach, California. Lowe's entire molluscan collection was deposited in the San Diego Museum of Natural History after his death in 1936 and thus the paratypes of *M. r. mexicana* returned by Dr. Pilsbry after study are now there.

Micrarionta (Eremarionta) rowelli mexicana Pilsbry & Lowe 1934 Pilsbry & Lowe, The Nautilus 48: 67.

Description: "The shell is light pinkish cinnamon on the spire and in an ill-defined band below the suture of the last whorl, which is elsewhere paler, nearly white. Shape nearly that of the type of *M. rowelli* and *M. desertorum;* subsequent whorls, up to the growth-rest line near the end of the penult whorl, with regularly arranged papillae, decidedly more distinct than in *M. hutsoni,* the last whorl smooth except for light growth ripples. Height 7.8 mm., diam. 14.8 mm." – Pilsbry & Lowe.

Sonora: Near the main travelled road and ca. 12 miles south of Sonoyta (a border town south of Lukeville, Arizona); H. N. Lowe, 27 February 1934 – type material; some alive clinging to undersides of rocks.

The Lowe paratypes (San Diego Museum of Natural History molluscan type collection No. 447) are 14 shells; they were evidently in two cabinet lots, one coming to the museum with the collection and the other donated at another time, perhaps earlier. The paratypes average 7.0 mm. high and 14.0 mm. diam., three of them are illustrated here (Pl. 14, fig. 1).

Fig. 1 — Paratypes (S. D. M. N. H. No. 447.) x 3

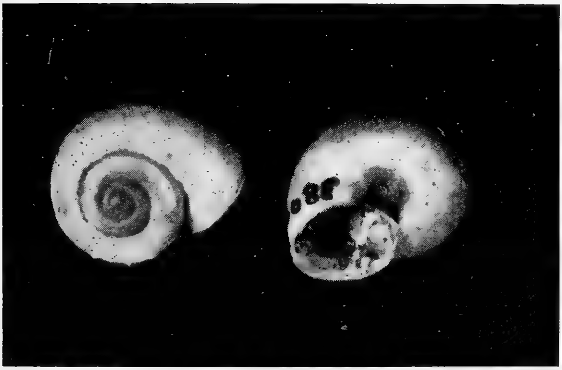

Fig. 2 — Topotypes (S. D. M. N. H. No. 38009.) x 3

Micrarionta rowelli mexicana Pilsbry & Lowe.

PLATE 14

San Diego Museum No. 38009 is for 6 topotypes of *M. r. mexicana* collected on 1 March 1934 by Mr. Laurence M. Huey, vertebrate zoologist on the Museum staff (then and now), at the type locality ca. 12 miles south of the border and during the return trip from Punta Peñasco described by Lowe (1934); two specimens shown (Pl. 14, fig. 2).

During the 1934 trip with Lowe, Mr. Huey collected 5 shells of *M. r. mexicana* (S. D. M. N. H. 38010) on rocky hills at Punta Peñasco, Sonora; they are illustrated (Pl. 15, fig. 1) and measure 5.0-7.0 mm. high and 12.0-15.0 mm. diam.

Pilsbry and Lowe (1934) stated the specimens of *M. r. mexicana* were very much alike and in that paper first expressed the opinion that *Micrarionta hutsoni, M. desertorum,* and the Sonora form described were all local races of *M. rowelli,* making a very widespread distribution with "an astonishingly discontinuous range". Later, and in a monographic treatment of the genus, Pilsbry (1939: 228-230) assigned *M. hutsoni* and M. *desertorum* and eight other forms in southern California and Arizona to the "group of *M. rowelli*" and placed them in the subgenus *Eremarionta.* Also mentioned was the occurrence of "a smaller form" of *M. rowelli* "from rocky hills at Punta Libertad", Sonora, collected by Lowe, "which sometimes shows a weak, narrow band".

Nothing other than the brief reference by Pilsbry (1939: 230), was published regarding Lowe's findings during a 1935 trip to Punta Libertad and Kino Bay, Sonora. This, according to information kindly given me by Mr. Huey, was a much longer trip than the one to Punta Peñasco in 1934 and lasted six weeks. The members of the expedition (Lowe, Huey, M. Bloomfield, and Phil Lichty) entered Sonora at Sásabe, went through Altar to Punta Libertad and remained there from about 28 January to 10 February. They then went again through Altar and then to Hermosillo and afterward to the coast arriving at Kino Bay on 14 February; they remained at Kino Bay until 27 February and arrived back in San Diego about 1 March 1935. Mr. Huey said that Lowe looked unsuccessfully for land shells at many places during their travels inland; none were discovered in my 1954 study of Mexican things in the Lowe collection.

There are 20 specimens of the smaller race of *Micrarionta rowelli,* and noted by Pilsbry as from near Punta Libertad, in the San Diego Museum (No. 13105). They measure 3.0-5.0 mm. high and 10.0-13.0 mm. diam. and were collected by Lowe in February 1935; four of them are illustrated (Pl. 15, fig. 2). Punta Libertad is about 100 miles south of Punta Peñasco and lies about half way between Kino Bay and Punta Peñasco. Therefore, as now known by the Lowe specimens, *Micrarionta* extends nearly 200 miles down the eastern shores of the Gulf of California. From the general small size of this form as compared to most of the others in

Fig. 1.—Punta Peñasco, Sonora, México
(S. D. M. N. H. No. 38010.) x 3

Fig. 2—La Libertad, Sonora, México,
(S. D. M. N. H. No. 13105.) x 3

Micrarionta rowelli mexicana Pilsbry & Lowe.

PLATE 15

the genus and the depression of the spire as illustrated in the few specimens known, it would seem that it would be an old form in the desert area and probably going out with increasing aridity. A north-south cline for size would seem to be evident, as well; aridity factors may not be totally responsible for this.

On 3 May 1953, Dr. Albert R. Mead of the University of Arizona Department of Zoology, and I made a search for living specimens of *M. r. mexicana* in hills east of the paved highway at approximately the type locality 12 miles south of the border. Nothing other than an incomplete shell (University of Arizona Invertebrate Museum No. 207) of the form was found. As the anatomy of the Sonoran representative of *Micrarionta* is apparently unstudied — at least it is not reported upon in the literature of the area and genus known to me — examination of fresh and/or properly preserved animals of this unique form would be in order for anatomical and thus further phylogenetic study.

These notes are partially from study of Mexican pulmonates in Sonora (1951-1952) under Penrose Fund support from the American Philosophical Society; a National Academy of Sciences Bache Fund grant-in-aid made Mexican landshell research possible at the San Diego Museum in the summer of 1954. At that time a report (with illustrations) on the specimens of *Micrarionta* was submitted to a journal for publication. The registered envelope containing the manuscript was delayed in the mails for well over a year; in the lapse of time the journal ceased to function. As the original paper and photographs were not returned to me, it became necessary to again photograph the shells as in some way the negatives had become damaged. In April 1957 Mr. Emery P. Chace, curator of molluscan items in the San Diego Museum, kindly arranged for a loan of the micrariontas for the re-photographing.

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A NEW GENUS OF HAUSTORIID AMPHIPOD FROM THE NORTHEASTERN PACIFIC OCEAN AND THE SOUTHERN DISTRIBUTION OF *UROTHOE VARVARINI* GURJANOVA*

By J. LAURENS BARNARD

While identifying crustaceans collected from the continental shelves off southern California (Hartman 1955, 1956) the writer dissected specimens tentatively identified with the genus *Haustorius*. Examination of the mouthparts of these animals showed that they were quite dissimilar to the type species *H. arenarius* (Slabber) and should be segregated as a new genus, described below. In addition, it was discovered that *Urothoe varvarini* Gurjanova, another haustoriid, is a widespread inhabitant of this region and is discussed below.

The writer is indebted to Dr. Olga Hartman and the Allan Hancock Foundation for aid in this study.

Family HAUSTORIIDAE

Eohaustorius, new genus

DIAGNOSIS. — Antenna 1 not geniculate, accessory flagellum poorly developed, biarticulate; peraeopods 4 and 5 with fourth and fifth articles greatly expanded; gnathopods 1 and 2 with third article short; maxilla 1 with a very small inner lobe; maxilla 2 with lobes subequal in length and shape; maxilliped with palp article 3 not geniculate; lobes of telson widely separated and attached divergently to the urosome; peraeopod 2 unlike peraeopod 1, similar to peraeopod 3; pleopods well developed.

TYPE SPECIES. — *Haustorius washingtonianus* Thorsteinson 1941.

REMARKS. — This genus differs from *Haustorius* Müller by the short accessory flagellum, the shape of the maxillae and maxillipeds, the attachment of the telson and the dissimilar first 2 pairs of peraeopods. Unlike most genera of amphipods the second peraeopod is oriented so that it appears to be a small accessory appendage with a shape similar to peraeopods 3 to 5.

The species *Haustorius eous* Gurjanova 1951 (including the subspecies *H. e. robustus* Gurjanova 1953) and *H. cheliferus* Bulycheva 1952 appear to belong to *Eohaustorius* on the basis of their telsons, accessory flagella, and second peraeopods, although their mouthparts remain undescribed.

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* Contribution No. 193 from the Allan Hancock Foundation, University of Southern California

In this way the genera *Haustorius* and *Eohaustorius* would be composed of:

Haustorius arenarius (Slabber). North Atlantic.
Haustorius americanus Pearse. Caribbean.
Eohaustorius washingtonianus (Thorsteinson). N. E. Pacific.
Eohaustorius eous (Gurjanova). Okhotsk Sea.
Eohaustorius cheliferus (Bulycheva). Japan Sea.

The writer is unable to recognize a distinct difference between *H. eous* and *H. cheliferus* although article 5 of peraeopod 2 appears slightly different in the drawings of the two species. The first 2 peraeopods of *H. eous robustus* Gurjanova 1953 were mislabeled.

Eohaustorius washingtonianus (Thorsteinson) new comb.
(Plate 16)

Haustorius washingtonianus Thorsteinson 1941: 61-62, pl. 4, figs. 39-51.

NOTES. – The figures accompanying this paper obviate the need for a description. The specimens are very close to the figures and description given by Thorsteinson, the presence of an upward pointing cusp on article 2 of peraeopod 5 being a distinctive correspondence.

On the second antennae are stiff, stout sensory setae, each inserted into a capsule attached to the surface of the chitin.

The mouthparts of *H. washingtonianus* were confused by Thorsteinson. She figured and labeled as maxillipeds the composite of the lower lip and second maxillae which often are removed and mounted together during dissection.

MATERIAL EXAMINED. – *Velero* stations 2312-53 (6), 4810-57 (2), 4819-57 (45).

DISTRIBUTION. –The amphipods from more than 500 samples taken from depths of 5 to more than 500 fms have been examined. The present species occurred in only 3 of those, indicating that the southern California coast may represent the southern limits of the species described from Washington. Its scarcity may be related also to the sparsity of coarse gray and brown sands on which it has been found. It is of interest that the species was associated with the only two collections taken of a new genus of phoxocephalid, being described elsewhere. Station 4819 is close to Pt. Conception in 10 fms, Station 4810 is off Santa Barbara in 8 fms, and Station 2312 is in 7.5 fms, on the San Pedro shelf near Long Beach, about 135 miles south of Pt. Conception.

Urothoe varvarini Gurjanova

Urothoe varvarini Gurjanova 1953: 219-221 figs. 3, 4.

IDENTIFICATION. –Specimens were dissected and compared closely with the figures of Gurjanova. They corresponded in all respects, including the presence of the slightly serrated distal spines on the first 2 peraeopods.

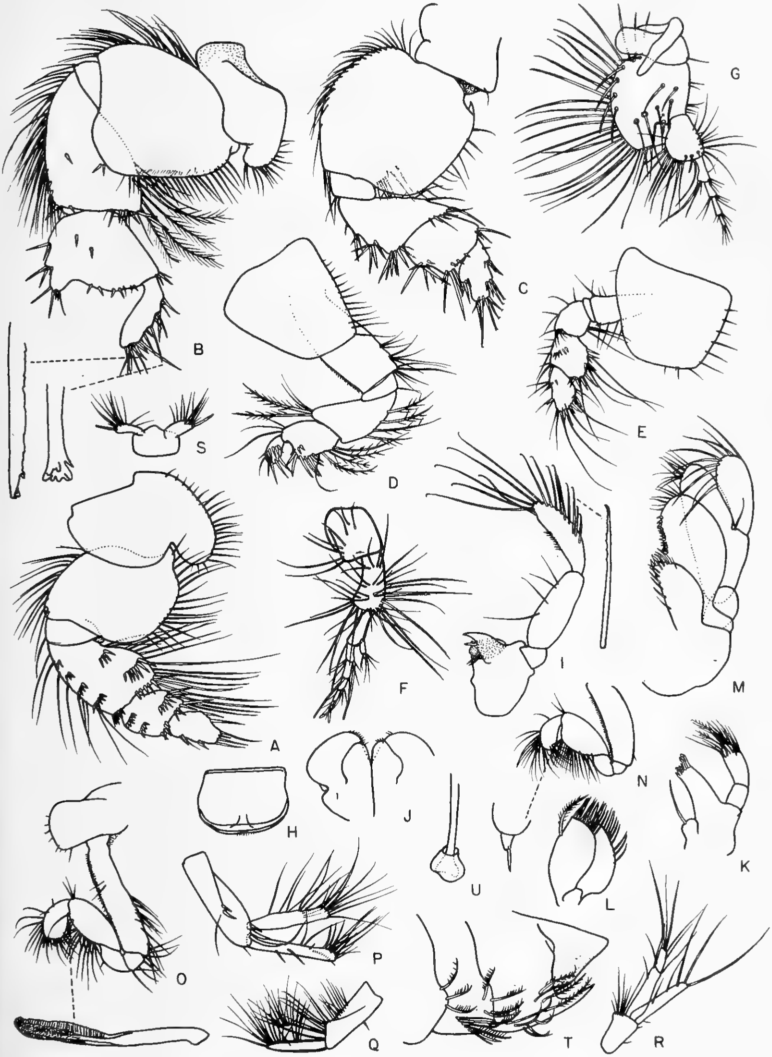

PLATE 16

Eohaustorius washingtonianus, female 5 mm, station 2312-53.

Figs. A-C, peraeopods 3-5; D,E, peraeopods 1,2; F,G, antennae 1,2; H, upper lip; I, mandible; J, lower lip; K, maxilla 1; L, maxilla 2; M, maxilliped; N, O, gnathopods 1,2; P-R, uropods 1-3; S, lobes of telson; T, epimera 1-3; U, base of sensory seta antenna 2.

Remarks. — This species is very closely related to *U. elegans* Bate and possibly should be a subspecies of that Atlantic form. Its distinction hinges on whether the concentrated grouping of setae on the lower part of article 2, peraeopod 4, was overlooked by Europeans working on *U. elegans* (see Sars 1893 pl. 47). These setae are easily overlooked, especially on animals which have not been properly cleaned of the debris usually clinging to preserved amphipods. The morphological difference, if valid, may be worth only subspecific rank.

Material examined. — *Velero* stations 2126-52 (6), 2153-52 (11), 2232-52 (3), 2344-53 (1), 2347-53 (9), 2348-53 (17), 2349-53 (4), 2394-53 (1), 2413-53 (1), 2414-53 (1), 2498-53 (13), 2629-54 (18), 2995-55 (4), 2996-55 (1), 2998-55 (29), 3034-55 (1), 3166-55 (1), 3204-55 (1), 3388-55 (3), 3389-55 (12), 3394-55 (17), 3572-55 (5), 3573-55 (10), 3616-55 (9), 4318-56 (27), 4753-56 (1), 4820-57 (2). The ratio of males to females in the above samples was about 1.0:3.6.

Distribution. — *Urothoe varvarini* is known from the Okhotsk Sea and southern Sakhalin. The present materials extend its range several thousand miles south to the southern California coast. It occurs on the continental shelf and slope in depths of 29 to 210 fms, the median depth of the above stations being 50 fms. It is usually associated with shelly, rubbly or gravelly bottoms mixed with silt or sandy silt from Pt. Conception to Pt. Loma, California.

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DESCRIPTIONS AND RECORDS OF SOME CERAMBYCIDAE FROM BAJA CALIFORNIA (Coleoptera)

By E. GORTON LINSLEY
University of California, Berkeley

The following records and descriptions are supplemental to a more comprehensive treatment of the Baja California Cerambycidae published earlier (Linsley, 1942).

CROSSIDIUS TESTACEUS LeConte

This species has been taken thirty-two miles south of Tijuana and thirty-one miles north of Ensenada, August 31, 1934, of flowers of *Aplopappus venetus vernonoides* by P. H. Timberlake. It is more finely punctate than *C. australis* Linsley (from San Quintin, Hamilton Ranch, and Rio San Telmo on *Aplopappus parishii),* and lacks the dark sutural stripe.

RHOPALOPHORELLA FASCIATA (LeConte) new combination

Gracilia fasciata LeConte, 1873, Smithson. Misc. Coll., vol. 11, no. 264, p. 181.

Rhopalophora bicincta Horn, 1895, Proc. Calif. Acad. Sci., ser. 2, vol. 5, p. 245. New synonymy.

The type of *Gracilia fasciata* LeConte is in the Ulke Collection in the Carnegie Museum at Pittsburgh. Its structural characters will not permit its inclusion in the Graciliini and it seems to be the same as *Rhopalophora bicincta* Horn, although the above synonymy is not based upon an actual comparison of specimens. Both names were based upon unique specimens from Lower California, although the LeConte type bears the label "Cal."

OBRIUM DISCOIDEUM LeConte

Taken at Todos Santos, October 10, 1941 by E. S. Ross and G. E. Bohart. *O. discoideum* also occurs in southern Arizona where it has been found in Baboquivari Canyon, west side of Baboquivari Mts., Pima Co., July 25-27, 1952, by H. B. Leech and J. W. Green. In these latter specimens the central cloud of the elytra tends to be darker, the enclosed pale area reduced.

Obrium dominicum Linsley, new species

Obrium constricticolle, Linsley (not Schaeffer), 1942, Proc. Calif. Acad. Sci., ser. 4, vol. 24, p. 51.

MALE: Form moderately small, subparallel; integument pale brownish-testaceous, elytra sometimes clouded with picious along sides at middle, more rarely also at base and apex, leaving pale

areas in form of a cross; punctation moderately coarse, sparse; pubescence sparse, suberect. *Head* with a few coarse punctures on vertex between eyes; eyes separated above by about one-sixth of greatest width of head; antennae exceeding elytral apices by about two segments, segments minutely clothed with fine appressed pubescence, with a few larger, coarse suberect hairs on basal segments, scape a little longer than third segment, third segment barely shorter than fourth, fifth segment longer than fourth, subequal to sixth, segments six to ten successively decreasing in length, eleventh segment a little longer than tenth. *Pronotum* a little longer than broad, apex nearly one and one-half times as wide as base, moderately constricted in front of lateral tubercle, disk moderately coarsely, sparsely punctate, the punctures as large as those at base of elytra, mostly separated by several diameters, each bearing a long, coarse, erect hair. *Elytra* about two and one-half times as long as basal width; surface moderately coarsely punctate near base where punctures are mostly separated by about two diameters, a little coarser and denser near middle, apex almost impunctate, each puncture bearing a sub-erect hair; apices separately rounded. *Legs* with posterior femora moderately clavate, very sparsely punctate, with a few long suberect hairs. *Abdomen* shining, sparsely punctate; fifth sternite broadly truncate and shallowly emarginate at apex. Length, 4.5 mm.

Female: Eyes separated above by one-third of greatest width of head; antennae barely attaining elytral apices; abdomen abbreviated and modified. Length, 6 mm.

Holotype male (Calif. Acad. Sci., Ent.) from San Domingo, Baja California, July 19, 1938 (A. E. Michelbacher and E. S. Ross), allotype female (Calif. Acad. Sci., Ent.) and eight paratypes, same data.

This species was previously identified by me as *O. constricticolle* Schaeffer. However, the recent acquisition of representatives of the latter species from the mountains of southern Arizona has revealed that two species are involved. *O. constricticollis* is wholly piceous or brown, with the pronotum very sparsely punctate, the punctures being much smaller than those of base of elytra, and the pronotum is more strongly constricted before the apex. *O. peninsulare* Schaeffer, described from Santa Rosa, Baja California, is larger than *O. dominicum* (7-7.5 mm. as compared with 4.5-6 mm.), with the elytra more evenly coarsely, and closely punctate, the punctures averaging less than two diameters apart, the abomen dullish and tessellate, and the eyes more narrowly separated above in the male.

Compsa lecontei Linsley, new species

MALE: Form elongate, subparallel; integument piceous, dull; pubescence very fine, short, appressed, with scattered long erect hairs on pronotum and about three rows of such hairs on elytra. *Head* very finely, densely punctate above, with scattered coarse punctures; inner emargination of eyes, densely clothed with appressed white pubescence; antennae exceeding elytral apices by about four segments, segments three to seven thickened, carinate, three and four ciliate internally, third segment more than twice as long as scape, much longer than fourth, fifth segment longer than fourth, shorter than third, sixth segment longer than fifth, segments six to ten successively decreasing in length, eleventh segment longer than tenth. *Pronotum* less than twice as long as basal width, sides very feebly arcuate, surface very finely punctate above, clothed with fine appressed pubescence except for a median longitudinal smooth line and a pair of vague anterior discal calluses, sides finely, closely striate; prosternum impressed in front of coxae and very finely punctate and pubescent, smooth anteriorly; meso-and metasternum dull, finely, densely punctate, moderately densely pubescent. *Elytra* more than three and one-half times as long as basal width; surface finely, densely punctate and pubescent, with coarse punctures superimposed, and about three sparse rows of coarse erect hairs; apices separately rounded. *Legs* with femora clavate, finely punctate and pubescent; posterior tibiae not carinate. *Abdomen* dull, finely densely punctate moderately densely pubescent; fifth sternite broadly truncate at apex. Length 9.75 mm.

HOLOTYPE MALE: (Calif. Acad. Sci., Ent.) from six miles north of Triunfo, Baja California, July 15, 1938 (A. E. Michelbacher and E. S. Ross).

This species bears a remarkable superficial resemblance to *C. puncticollis* LeConte, with which it was attracted to light at the same locality. However, it is very distinct in the very finely punctate and pubescent pronotum with its glabrous dorsal calluses, finely punctate prosternum in the male, dull, densely punctate meso- and metasterna and abdomen, and the more slender form with the elytra more than three and one-half times as long as basal width. In *C. puncticollis* the pronotum is rather coarsely, contiguously, and to some extent confluently, punctate, without dorsal calluses, the prosternum is coarsely densely punctate in front of the coxae in the male, the thoracic sterna and abdomen are shining and sparsely punctate, and the elytra barely more than three times as long as basal width.

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LIFE HISTORIES OF TWO SOUTHERN ARIZONA MOTHS OF THE GENUS CARIPETA

By John Adams Comstock

Del Mar, California

During the summer of 1956 the Entomological Department of the Los Angeles County Museum sponsored a field operation in southern Arizona, with which the writer was privileged to be associated.

A considerable portion of our time was spent collecting in Pinery, Canyon, Chiricahua Mountains, Cochise County, at an elevation of 7200 feet. The public camp ground which served as our headquarters is in the Douglas fir – ponderosa pine association, with a few intrusions in the canyon from the pinyon —juniper belt. Particularly noted were the large number of species of *Quercus*, of which four grew in close association. These were Arizona white oak, Gambel oak, netleaf oak and whiteleaf oak.

This plant association was particularly favorable for the occurrence of geometrid moths. Two species in particular, which had formerly been considered very rare, were taken at light in long series. These were *Caripeta hilumaria* Hlst. and *Caripeta macularia*, B. & McD.

Gravid females were taken at light, and laid readily in captivity, which made possible the following records.

Caripeta hilumaria Hlst.

A female of this species was captured July 3, and laid numerous eggs July 4.

Egg. – Elongate-oval. Both ends are well rounded. The side walls taper slightly towards one end. The eggs are laid singly, each one being deposited on its side. The color is, at first, a leaf green, changing to a rich brown just before hatching. Size,— .8 mm. long by .5mm. wide.

There are approximately 12 slightly raised longitudinal nodular ridges. The spaces between the ridges are finely striated. There are about 25 of these striations or 'grills', each one running transversely from nodule to nodule of the approximated ridges. The form and texture of this beautiful egg are clearly shown in the accompanying plate No. 17, fig. B.

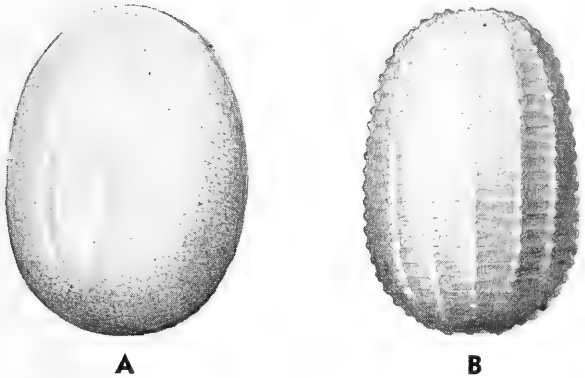

PLATE 17

Fig. A. Egg of *Caripeta macularia* B. & McD., enlarged approximately X 36.

Fig. B. Egg of *Caripeta hilumaria* Hlst., enlarged approximately X 50.

Reproduced from painting by the author.

The eggs hatched July 15, 1956.

It was suspected that the larvae were pine feeders. They steadfastly refused both pine and fir, however, and they also turned up their noses at juniper. They were then offered, *Prunus,* and oak of several species, without results. Starvation began to take its toll, so, in desperation, they were given black walnut, and willow. Much to our surprise they accepted willow.

Probably however, this is not their food plant of choice, as they did not thrive on it, and only one example was finally carried through to maturity.

FIRST INSTAR LARVA. – Length, 3.5 mm. In form, it is a typical elongate cylindrical 'looper' with a single pair of prolegs, and anal prolegs.

Head, dull orange, with black ocelli, and mouth parts edged with brown. It is wider than any body segment.

Body. – A wide longitudinal brownish black band extends the length of the dorsum. Laterally, the body is light yellow. The ventral surface is brownish black.

INTERMEDIATE INSTAR. – A single larva remained, in apparently healthful condition on July 30. It measured 19 mm. in length.

Head. – width, 1.1 mm., which was slightly narrower than the first segment. In color, it is mottled light brown, shading to light gray-green marginally. Antennae, white on proximal segments, and dark on the tips. Ocelli, black.

Body. – cylindrical, tapering slightly towards the head on the first three segments, and relatively uniform from the fourth segment to cauda. The last segment is triangulate.

The dorsal area is a dull olive green, with a middorsal darker stripe edged with light olive, lateral to which is a dark olive band.

From the fifth segment to the cauda these bands widen laterally to form elongate triangles on each segment, then narrow and fuse at each segmental juncture.

Slightly anterior to each segmental juncture, from the fourth to ninth, the white margins of the triangles send a narrow line transversely for a short distance, then this line turns abruptly and runs caudally for about .7 mm. forming a cross with dropped arms on each segment. The dorsal triangles narrow progressively from the tenth segment to the caudal tip.

Stigmatally there is a wide longitudinal band of olive-gray.

The ventral surface is a mottled olive-brown.

Legs, olive-brown. The single pair of prolegs and anal prolegs are light olive-gray on their outer surfaces, and olive-brown on inner surfaces. The spiracles are black, with light olive-gray margins.

When resting, the larva spins a single strand of silk from the food plant to its spinnerets.

Final instar. – On August 9 the larva measured 28 mm. in length.

Head. – Width, 3 mm. Heart-shaped and relatively flat. The color is mottled brown with lighter stippling around the margin. Ocelli; first two (anterior), dark brown, the remainder tending toward hyaline, placed on a white base. The clypeus is white, and mandibles, dark brown.

Antenna. – The basal segment is white, and more than twice the width of the middle segment. The terminal two segments are brown.

Setae, short and black.

Body. – The surface is completely covered with minute, slightly elevated nodules, which give it a frosted appearance.

The predominant color is various shades of brown, with geometric patterns in brownish black or cream. The area below the stigmatal line is a mottled dark brown. Dorsally the first four segments above the stigmata are a light mottled brown with no definite pattern. From the fifth to ninth segments there is an irregular light creamy band forming a series of longitudinally placed triangles, connected at their ends, each expanding in the

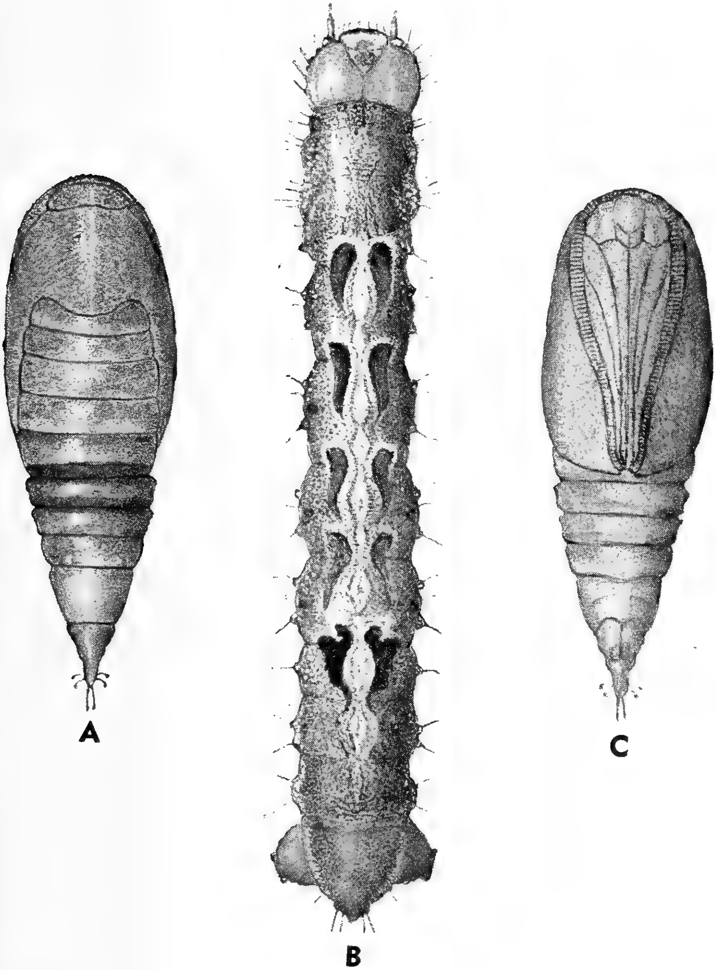

PLATE 18

Mature larve and pupa of *Caripeta hilumaria* Hlst.

Fig. A. Pupa, dorsal aspect, x 3¾. Fig. B. Mature larva, dorsal aspect, x 4½. Fig. C. Pupa, ventral aspect, x 3¾.

Reproduced from painting by the author.

center of a segment. This band is margined by a narrow black stripe. The caudal segments lack the middorsal triangles and are of a more uniform mottled brown.

Latero-inferior to the aforementioned band of triangles there occurs a longitudinal row of large comma-like figures, one to a segment on each side. These begin on the fourth segment and extend to the seventh. The corresponding figure on the eighth segment is irregular and darker than the others. These several markings are difficult to describe, but they are adequately shown on the drawing of the larva on Plate 18, fig. B.

Legs, brown, with cream colored segmental rings.

The single pair of prolegs are large, each having a mottled brown ground color, and a longitudinal line of large yellow spots on the lateral surface. The anal prolegs are mottled brown.

Spiracles, cream centered, narrowly rimmed with black. The short brown setae arise, for the most part, from brown papillae.

As the larva goes into the prepupal period it becomes a more uniform brown throughout. The white areas nearly disappear, becoming light brown or tan. The triangulate marks on the dorsum become less distinct.

Pupation occurred on top of the soil in the rearing cage, on August 26, 1956.

Pupa. – Length, 18 mm. Greatest width, 6 mm. Color, nearly black on cephalothorax and wings, shading into dark reddish brown on abdominal segments. The movable parts of the segmental junctures are a contrasting red-brown.

The surface texture is predominantly rugose, but on the cephalothorax and wings it is rugo-striated.

The eyes are not prominent, and are placed relatively close together. The antennae and maxillae extend to the edge of the wings.

The cremaster is an elongate cone, terminating in a pair of stout hooks .5 mm. long, the tips recurved dorsally. Half way between the base and tip of the cremasteric cone, and placed laterally thereon, are two pairs of small hooklets, only half the length of the terminal pair. These extend outwardly, almost at right angles to the long axis of the body. Their tips are recurved caudally. These, and other structural features of the pupa are shown in figures A. and C. of Plate 18. The drawing of the larva on this plate (fig. B) seems forshortened, owing to the fact that it was resting in an arched posture at the time that the drawing was made.

The single pupa gave forth a fully developed and perfect female on March 30, 1957.

Caripeta macularia B. & McD.

A female of this species taken at light laid a quantity of eggs on July 6, 1956.

EGG. – 1.2 mm. long by .8 mm. wide. The shape is a regular oval, the color, a delicate whitish cream, and the surface texture, finely granular, without ridges or sculpturing. There is no indication of a micropyle. See Plate 17, fig. A.

The eggs hatched on July 19, 1956, with each young larva exiting from one end, leaving the shell intact.

They were offered pine, cypress, willow, *Rhus* and oak, and immediately took to the oak.

FIRST INSTAR LARVA. – Length, 4.25 mm. Cylindrical, except for the head and first three segments, which are considerably larger and wider. The head is widest, and the succeeding three segments taper progressively to their juncture with the fourth. From there to the cauda, the width is uniform.

Head. We were unable to obtain measurements. The color is a delicate rosy straw, with black ocelli, and mouth parts edged with brown.

Body. The first three segments are tinged with light rose, but this gradually fades into the translucent light straw ground color of the remaining portion of the body.

There is an indefinite shaded patch of light gray, placed middorsally on each segment from the fourth to about the eleventh, becoming slightly more pronounced caudally. Similar patches occur ventrally on each segment, where, however, they are more clearly defined.

The legs are light straw, tinged with rose, and the pair of prolegs and anal prolegs are concolorous with the body.

Short colorless setae occur sparingly over the body surface.

MATURE LARVA. —Examples measured Sept. 10, 1956; length, 39 to 40 mm. Cylindrical, with a twig-like appearance, both in color and form.

Head, width, 4 mm. Strongly bilobed, the surface rugose, and heavily blotched with spots and patches of tan, red-brown and chocolate.

The front is depressed, the upper half speckled tan and red-brown, and the lower half uniform brown. The adfrontal sutures are dark brown, the clypeus is streaked ivory and brown, and the mouth parts are mottled brown. The antennae are dark brown, and the ocelli are black, with one being placed on a white field.

Body, cylindrical, with a warty ridge topping the fourth segment transversely, and a dorsally placed prominence on the tenth segment.

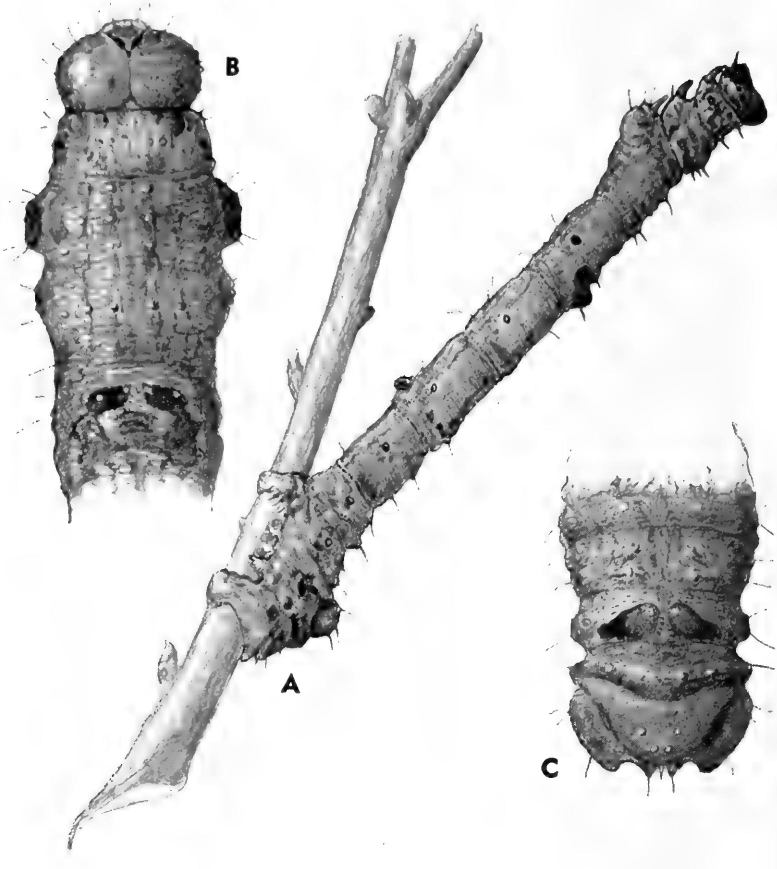

PLATE 19

Mature larva of *Caripeta macularia* B & McD.

Fig. A. Larva, lateral aspect, enlarged approximately X 2½.

Fig. B. Head and first five segments of larva, dorsal aspect, enlarged approximately X 6.

Fig. C. Caudal segments of larva, dorsal aspect, enlarged approximately X 6.

Reproduced from painting by the author.

The prevailing color seems to be a gray-brown, but is actually produced by numerous dots, dashes, short crenulated lines and blotches in various shades of yellow, gray-tan, brown and chocolate. These combine to form indefinite geometric patterns, more noticeable at the cephalic and caudal portions than on the middle segments.

The widest segment is the second, due to a lateral bulge on each side. Ths segment is 4 mm. wide.

The dorsal prominence on the fourth segment is mottled chocolate and gray-brown.

A warty prominence, placed substigmatally on the sixth segment is yellow-brown.

The first pair of legs are relatively short; the second pair, intermediate in length, and the third pair markedly protruded owing to a heavy basal expansion of the body on which they are placed. All are mottled gray-brown and yellow-brown, as are also the pair of prolegs, and anal prolegs. Between the prolegs and anal prolegs there are several branching excrescences, which are somewhat hyaline, and dull pink.

Numerous small yellow papillae occur over the body, each topped by a short black seta.

The spiracles are dull yellow, rimmed with dark brown circlets.

The pattern and markings of this larva are too complicated to be described, and are best set forth in the accompanying Plate 19. [Special note. The description and drawing of the mature larva must, at present, be considered tentative, for the reason that in the final emergence of numerous imagines of *C. macularia,* two examples of *Phaeoura cristifera* Hlst. appeared. These must have been introduced as young larvae on the foodplant. It is very unlikely that the single larva chosen at random from among the many Caripetas for illustrating was a *Phaeoura,* but an additional rearing must be made to eliminate any doubt. There is, however, no uncertainty as to the egg, first instar larva, and pupa.]

The first larva pupated Sept. 13, 1956 in a loosely woven cocoon formed in the debris at the bottom of the rearing cage.

PUPA.—Length, 16 mm. Greatest width through center 5.2 mm.

The anterior portions including the wings are heavily rugose, and dark chocolate in color. The abdominal segments are a lighter red-brown, with the edges of all movable segments slightly tinged with green. The surface of these segments is finely rugose.

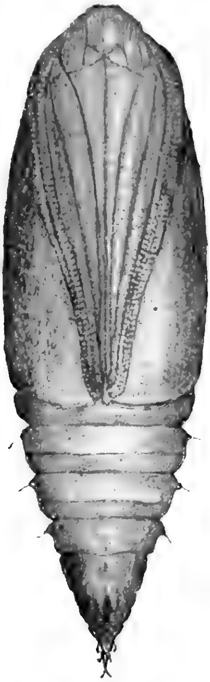

PLATE 20

Pupa of *Caripeta macularia* B. & McD., ventral aspect, enlarged X 5⅔. Reproduced from painting by the author.

The head is narrow, and well rounded. The antennae extend to the edge of the wing cases, and the tips of the maxillae reach a point 1 mm. short of this.

The cremaster ends in a pair of brownish black spines, .4 mm. long, which are recurved outwardly. Lateral thereto is a pair of short yellowish hooklets.

The pupa is illustrated on Plate 20.

The first imago emerged March 15, 1957. Subsequent emergences were on March 31, May 3, 4 and 29. Numerous viable pupae on hand will probably give forth imagines in June.

By comparing the differences between the eggs, and pupae of the two species herein discussed, it will be noted that there is such marked disparity in these stages as to suggest that they may not belong to the same genus.

SCIENTIFIC NOTES

THE PRAIRIE RATTLESNAKE AT GRAN QUIVIRA NATIONAL MONUMENT, NEW MEXICO

One of the common animals of the Chupadera Mesa at Gran Quivira, New Mexico, is the prairie rattlesnake, *Crotalus viridis viridis* (Rafinesque). Since August 1954, the senior author has collected data on the occurrence of this snake in a 15 acre area. Intensive surveillance has been maintained over a 4 acre daily working area at 6,650 feet elevation comprising 0.75 miles of unpaved road, 0.5 miles of paved trail and 0.5 miles of unpaved trail. Scattered through the region are mounds of tumbled Chupadera limestone and weed free ruin areas of approximately one acre extent. The entire site covers a large hill with gentle slopes dropping away gradually in every direction except to the east where the terrain is level with the top of the hill. The rounded hilltop receives greatest insolation along the crest and south sides and this is where most rattlesnakes have been found. On a partly cloudy day with scattered light showers, 6-VII-56, one 304 mm juvenile with button was so relaxed in the radiating heat from the macadam trail at 3:15 PM that while guiding visitors, the junior author crushed it under the left foot before noticing the specimen. On a windy, clear day, 25-VIII-56, one 800 mm specimen was observed at 10 AM in a northwest-southeast resting position on a south slope of tumbled pueblo limestone completely quiescent in sun bathing until disturbed by contact with a snake stick.

The dominant vegetation is one-seed juniper, *Juniperus monosperma,* cane cholla cactus, *Opuntia imbricata,* and salt bush, *Atriplex canescens,* with scattered smaller shrubs, wild flowers, and grasses varying with the seasons.

The physical characteristics of this region suggest a suitable denning area although no actual den or migration of rattlesnakes has been observed. However, there are no prairie dogs here and the burrows available are chiefly kangaroo rat, *Dipodomys,* or wood rat, *Neotoma,* plus natural subterranean limestone cavities. From the frequency of rattling, the rapidity of escape movements, the prompt assumption of striking posture, the sensitivity to snake stick contacts and length of time in rattling, a definite impression of aggressiveness was obtained in handling these snakes for removal to safer locations. These observations are similar to those recorded by Klauber (1956, Rattlesnakes, 2 vols., Univ. of Calif. Press).

Since weather data are recorded at this station, some correlations can be made with temperature and rainfall. All temperatures are here recorded in degrees Fahrenheit. Very slight amounts of rainfall preceded all spring appearances. Prior to 1953, observations were recorded by Superintendent Ray B. Ringenbach. Records of first appearances in the spring with maximum and minimum temperatures for that day are as follows: 13-IV-52, 62-30; 31-III-54, 60-27; 9-IV-55, 64-25; and 5-IV-56, 63-28. Records for last observations for the year are: 14-XII-52, 52-24; 30-XI-53, 63-25; 20-XI-54, 65-20; 26-XI-55, 59-25; and 11-XI-56, 70-30. The average corresponding temperatures for the prior ten day periods were 60.5-29.7 in the spring, and 56.5-24.5 in the fall. The December 14th prairie rattlesnake was observed wriggling through 4 inches of snow. There appear to be no apparent correlations here with rainfall and temperature but

insolation may be important in their appearance on the surface of the ground since these occurrences are associated with clear skies. For 25 snakes seen in September, 18 were noted on clear days, 6 on partly cloudy days and 1 on a cloudy day. For 25 snakes observed in October, 9 were found on clear days and 16 on partly cloudy days. For 45 snakes seen in April, 29 were observed on clear days, 10 on partly cloudy days and 6 on cloudy days. Records for 144 rattlesnakes observed from '54 through '56, reveal that 73 were noted during clear weather, 63 during partly cloudy and 8 during cloudy weather.

The highest resident contact ratio was recorded by Supt. Ringenbach in April of 1952, when 32 were seen although there is no note that these were all different snakes. The following ratios for '54 through '56 are known separate individual contacts. In 1954, from March 31st through November 20th, 32 recorded specimens were known plus 6 estimated for November, making a total of 38. Of these, 3 were met by visitors for a contact ratio of 1 to each 1,505 visitors. However, the contact ratio for the resident supervisors was 1 rattlesnake every 5.9 days.

In 1955, a total of 56 rattlesnakes were noted including one western diamondback, *Crotalus atrox*. For the period April 9th through November 26th, 2 prairie rattlesnakes were met by visitors for a contact ratio of 1 to 2,337. The probability for the resident supervisor meeting a rattlesnake was 1 every 4.3 days.

In 1956, 56 prairie rattlesnakes were met from April 5th through November 11th. The visitor contact ratio was 1 to 508, while the resident contact ratio was 1 every 4 days.

For the months of greater contact abundance the ratio of POSSIBLE contacts for visitors was 1 in 52 for '54, 1 in 22 for '55, and 1 in 29 for '56 during April, and 1 in 72 for '55 and 1 in 31 for '56 during October.— Channing T. Howell, Superintendent, and Sherwin F. Wood, Seasonal Ranger, Gran Quivira National Monument, Gran Quivira, New Mexico.

A DELAYED SKIN REACTION TO CONENOSE BUG FEEDING ON MAN

On July 3, 1956 two adult *Triatoma protracta* were obtained from the new residence at Chaco Canyon through the kindness of Superintendent Charles C. Sharp. These bugs were transported in a water cooler (Wood & Wood, 1952, Bull. So. Calif. Acad. Sci. 51:108-111) to Gran Quivira National Monument where they were fed on the writer. Both male and female bugs were removed from their culture jar and transferred at 8:54 AM to a plastic box pressed firmly against the tabletop with the left 5th finger. The male *Triatoma* began probing the skin immediately, stopping exploratory movements with the tip of the proboscis at 8:55 AM about ½ inch from the finger tip on the lateral surface. The short terminal segment of the proboscis was perpendicular to the skin surface with the other segments bent at about an 80° angle. No sensation of any type was noticed at the finger tip except pressure from contact with the plastic box. The female remained motionless near the male while the latter was feeding. By 9:00 AM the male's abdomen was beginning to round noticeably from above and the crossed wings were elevating from the posterior dorsal surface of the body. Except for slight motion of the antennae forward and backward at the beginning of feeding, the male held the two sense organs equidistant from and parallel to the skin surface even though the insect's body was not exactly at right angles to the finger axis. The bug continued proboscis contact without body movement from its original position. At 9:11 AM the male had fed to capacity as evidenced by the well rounded

upper surface of the abdomen and distinctly elevated wings and voluntarily drew away from the finger and immediately tried to crawl from the plastic box.

Meanwhile at 9:01 AM the female turned toward the finger, backed away and crawled out on the table top being replaced with forceps twice near the finger tip. At 9:02 AM the female stopped with proboscis in contact with a skin crease on the ventral side of the finger out of view of the writer. By 9:05 AM, the wing tips were elevating and abdomen rounding and at 9:12 AM contact was broken probably by the writer's movement of the finger but the bug appeared completely fed.

Thus, the male *Triatoma* fed to capacity in 16 minutes and the female in 10 minutes. Close inspection with a 10 power hand lens revealed no sign of physical change on the skin surface immediately after feeding as previously noted by Wood (1942, Jour. Parasit. *28*(1):43-49).

Four days after feeding of the bugs, the writer awoke at 6 AM to violent itching at the point of contact where the female had fed and noted a reddened discoloration of a slightly elevated area, 3 mm in diameter. After scratching intermittently for some 30 minutes, the itchiness subsided but the skin discoloration at point of contact with proboscis was still noticeable 6 days after the bug fed. This skin reaction is similar to the small vesicle response described by Shields & Walsh (1956, Arch. Dermat. *74* (1):14-21) with experimental feeding of *Triatoma sanguisuga*.—Sherwin F. Wood, Life Sciences Department, Los Angeles City College, Los Angeles 29, California.

BRIEF NOTES ON THE LIFE HISTORIES OF TWO ARIZONA GEOMETRID MOTHS

During the summer field trip of 1956, while collecting in the Tonto Creek Camp area, near Kohl's Ranch, Gila County, Arizona, brief notes were made on the life histories of *Philobia aspirata* Pearson, and *Pero modestus* Grossbeck.

There is apparently no information available in the literature on the metamorphoses of these two species, and it seems justifiable, therefore, to record the incomplete notes we were able to make at the time.

PHILOBIA ASPIRATA Pears.

While beating for larvae along the margin of the creek, on June 29, 1956, a number of larvae were secured from black walnut.

Four examples were reared to maturity, which made possible the following notes:

MATURE LARVA. Length, 23 mm. Cylindrical, and relatively long in proportion to width.

HEAD: Uniform green, of a slightly yellower shade than body; somewhat flattened; narrower than first segment. Antennae, green at base, shading to yellow at tip. Mouth parts tinged with yellow-brown. Mandibles margined with black. Ocelli, black. A few short, inconscpicuous, dark setae are scattered over the head.

BODY: Leaf-green, with a few soiled white longitudinal stripes occurring on the dorsum. A pair of these are placed mid-dorsally, and the area between them is of a slightly darker green than the general body color. A narrower longitudinal line parallels these dorso-laterally, and a third discontinuous line is present suprastigmatally. There is a wide yellowish band running stigmatally.

The spiracles are small, with yellow centers and brown circlets. They are relatively inconspicuous. The legs are yellow, and the single pair of prolegs, and anal prolegs are a uniform green.

Shortly prior to pupation the larva takes on a rose-plum shade over the dorsum, and loses some of the green.

Pupa: Length, 5 mm. Greatest width, 2.9 mm.

Color, brown. The cephalic end is evenly rounded. The antennae extend to the margins of the wings, and the maxillae terminate slightly beyond them.

The creamaster is pyramidal, ending in a single stout spur which is very slightly and minutely recurved at the tip.

The dorsal surface of the pupa is finely punctate, except for the smooth margins of the movable segments. The wing cases are smooth.

The dates of pupation, and emergence of the four larvae were:

(1) Pupated July 5, 1956. Emerged July 14, 1956
(2) Pupated July 8, 1956. Emerged July 18, 1956
(3) Pupated July 10, 1956. Emerged July 19, 1956
(4) Pupated July 11, 1956. Emerged July 20, 1956

Pero modestus Grossb.

A gravid female of *Pero modestus* came to light on the night of June 28, and deposited numerous eggs on gauze in the rearing cage. Some of these were laid in straight lines, but the majority were in irregular bunches.

The egg is oval in form, and is laid on its side. The top side is slightly concave. Its color is predominantly dull olive green, with irregular cream colored blotches at the ends which sometimes extend onto the sides. The surface texture is granular. No micropyle is apparent.

There is marked variation in the size, the average being 1.2 mm. long by .8 mm. wide.

All of the eggs hatched July 8, 1956.

Newly emerged larva: Length, 4.5 mm. Elongate and thread-like.

The head is much wider than the body, and is light brown, with black ocelli.

The body is dull olive-green on the dorsum, and olive on the venter. The caudal end is tinged with light tan. A whitish line runs longitudinally along the infrastigmatal fold.

The legs are olive-green. The single pair of prolegs are light olive, and the anal pair are tinged with light tan.

When resting, the larva stands nearly upright.

The colony were given oak, and apparently fed on it for a short time, but all had perished by July 20, 1956.

John A. Comstock

FIRST REPORT OF ARGAS REFLEXUS (FABRICIUS), A BIRD TICK, FROM SAN DIEGO COUNTY

Robert D. Lee

School of Tropical and Preventive Medicine, College of Medical Evangelists
Loma Linda, California

A large collection of ticks, kindly identified by G. M. Kohls, Rocky Mountain Laboratory, as *Argas reflexus* (Fabricius), was made by Mr. Fred N. Gallup in August, 1954. The ticks were taken from the nests of Cliff Swallows near Warner's Hot Springs, San Diego County, California.

This species has been reported by Cooley and Kohls (1944) from Ventura, Contra Costa, and Inyo Counties. However, this is the first known report of *A. reflexus* from San Diego County. Specimens have been deposited in the Rocky Mountain Laboratory and in the California Academy of Sciences.

LITERATURE CITED

Cooley, R. A. and G. M. Kohls.
1944. The Argasidae of North America, Central America and Cuba. American Mid. Nat. Monograph No. 1. 152 pp.

ACADEMY PROCEEDINGS

50TH ANNIVERSARY YEAR

1957 marks the fiftieth year of incorporation of the Southern California Academy of Sciences and it seems appropriate to pause and recapitulate on the growth and progress of our organization at this half-century mark.

This fiftieth year of the Academy's existence like the preceding forty-nine years, has been a year of progress and activity. Our monthly meetings have had excellent speakers and have been well attended. Our membership, while not as large as we hope it will be, has nevertheless been an active one, with individual members ranging to many corners of the earth in their scientific pursuits. The editorial program has been a vigorous one throughout the year with the publication not only of the regular issues of the "Bulletin" but of a new "Memoir" as well. The latter was published on September 9, 1956, as Volume 3, No. 3 of the Memoirs, entitled "Mites of Citrus Trees in Southern California," by E. A. McGregor. As a special anniversary bonus, a history of the Academy was published in time for distribution at the annual banquet.

In 1907 the Academy was granted its corporate charter for a period of fifty years. It was necessary to apply for a renewal of the charter this year, and in doing so, the Directors of the Academy requested that the organization be granted a corporate charter in perpetuity. The California Department of State has granted our request and it will no longer be necessary to renew the charter each fifty years.

The treasurer's report shows that our investments have been sound and that our finances are in excellent shape.

This anniversary year has seen the election of four members to the rank of Fellow. These are Dr. Walter Ebeling, Dr. John Garth, Dr. Floyd Parks and Dr. Fred S. Truxal.

At the annual dinner meeting in May, the Academy gave recognition to its oldest member by electing Mr. Theodore Payne to honorary life membership in the organization he has served so faithfully and well. Mr. Payne joined the Academy in 1898.

The committee on awards for research grants from the American Association for the Advancement of Science, after careful deliberation, awarded the grant of 1955-56 to Dr. Sherwin F. Wood whose research concerns the distribution of Chagas Disease trypanosome in insect vectors in New Mexico, and the 1956-57 to Dr. John D. Soule whose research project will be, "a clarification of the classification of the marine Bryozoa through a study of post-larval development and morphology."

As the year ends, our membership stands at 225 members with a gain of 15 new members and a loss of one by death. The membership in the Academy should grow more rapidly than it has. We are proud of our organization and are careful as to whom we admit to membership. We should, however, find an increasing number of worthwhile persons and encourage them to share the privileges and satisfactions we gain as members in this organization.

The fiftieth anniversary year has been a good year from my standpoint as out-going president, for I have had the task made easy by able and loyal help from many members whenever a problem arose.

KENNETH E. STAGER

Annual Report of the Treasurer for the Fiscal Year 1956-1957, ending April 23, 1957.

GENERAL FUND

Receipts		Disbursements	
Bank carry over 4/27/56	$1196.12	Printing & engraving	$3394.51
Membership dues	655.10	Annual meeting	155.40
Sale of publications	586.84	Monthly meetings	82.28
Investment returns	2467.83	Office expense & postage	306.33
Annual banquet	116.50	Portfolio investment	769.57
For memorial fund	137.27	Memorial fund	137.27
Borrowed from memorial fund	200.00	AAAS dues	8.00
Refunds	6.50	Corporation fees	15.20
		Balance in bank	497.60
	$5366.16		$5366.16

MEMORIAL FUND

Receipts		Disbursements	
Bank carry over	$1099.74	Lent to General fund	$ 200.00
Memorial Mrs. Hector Alliot	100.00	Balance in bank	1037.01
Interest on deposits	37.27		
	$1237.01		$1237.01

ASSETS		LIABILITIES	
Cash in General Fund	$ 497.60	Publications in press	$ 700.00
Memorial Fund	1037.01	Banquet receipts to date	84.00
Postage account cash	20.20	Safe deposit box	5.50
Postage on hand	15.97		$ 789.50
Securities, market value	52,450.31		
Inventory (approximate)	14,403.31		
Accounts payable	33.67	Net worth	$67,632.59
	$68,422.09		$68,422.09

W. DWIGHT PIERCE
Treasurer

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ACADEMY of SCIENCES

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●

Bulletin of the Southern California Academy of Sciences

Began issue with Vol. 1, No. 1, January, 1902. Issued ten numbers in 1902; nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908 — one issue only). Issued four numbers (January, May, July and October) in 1920.

The 1921 issues are: Vol. XX, No. 1, April; Vol. XX, No. 2, August; Vol. XX, No. 3, December.

The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

The 1924 issues are: Vol. XXIII, No. 1, January-February; No. 2, March-April; No. 3, May-June; No. 4, July-August; No. 5, September-October; No. 6, November-December.

From 1925 to 1956, including volumes XXIV to 55, three numbers were published each year. These were issued as No. 1, January-April; No. 2, May-August; No. 3, September-December, for each volume.

MEMOIRS

Vol. 1, 1938. Vol. 2, Part 1, 1939. Vol. 2, Part 2, 1944. Vol. 3, Part 1, 1947. Vol. 3, Part 2, 1949. Vol. 3, Part 3, 1956.

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(*Continued on next page*)

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Southwest Science Bulletin, May 5, 1920 (all published), chiefly Entomological, 1 color plate 1.00

Check-list of the Recent Bivalve Mollusks (of N. W. Coast of Am. from the Polar Sea to San Diego), W. H. Dall 1.00

A List of North American Lepidoptera in the Los Angeles County Museum. Part I Butterflies (Suborder Rhopalocera), Lloyd M. Martin and Fred S. Truxal. L.A. County Museum Science Ser. #18. Zool. #8, 1955. Price $1.00 (add 15 cents for tax and mailing).

Reprints:

Check-list of the Lepidoptera of Boreal America. Superfamilies Sphingoidea, Saturnioidea and Bombycoidea (printed on one side of page only, to allow of additional notes), Wm. Barnes and Foster H. Benjamin, 1927 $ .50

The Cacti of the Pyramid Peak Region, Dona Ana County, New Mexico, 1931. F. R. Fosberg .25

Check-list of the Macrolepidoptera of Canada and the United State of America by Dr. J. McDunnough, 1938 printed on white bristol board, one side of page (without index) suitable for labels. To Academy members, $1.50. To non-members 3.00

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BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Nostra Tuebimur Ipsi

VOL. 56 SEPTEMBER-DECEMBER, 1957 PART 3

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DESCRIPTIONS OF NEW SPECIES OF MARINE MOLLUSKS FROM WEST MEXICO

By LEO G. HERTLEIN

Many collections of marine mollusks were assembled by Templeton Crocker during expeditions to tropical west Mexican waters on his yacht ZACA. Research on collections in the California Academy of Sciences which resulted from those expeditions has revealed that one bivalve and two gastropods are undescribed forms.

Specimens of a gastropod of the genus *Acmaea* collected by Mr. and Mrs. Harry R. Turver at Punta Peñasco, Sonora, Mexico, and presented to the California Academy of Sciences likewise represent an undescribed species. Specimens of another small *Acmaea* differing in some details from any described species were collected at San Felipe, Lower California, by Mrs. Faye B. Howard. These new species and subspecies are here described and illustrated.

The writer wishes to acknowledge the generosity of the late Templeton Crocker, and of Dr. William Beebe who accompanied Mr. Crocker on two expeditions, for making specimens collected on those expeditions available for study. Acknowledgments are also due Mr. and Mrs. Harry R. Turver for specimens of the new subspecies of that genus.

The photographs used for illustrations on the plate were made by Mr. Charles E. Crompton, photographer, California Academy of Sciences.

Cardita spurca beebei Hertlein, new subspecies
Plate 21, figures 3, 4, 12, 13, 14

Shell ovately oblong, moderately thick, sculptured with about 18 trigonal, finely nodulose, radial ribs, those on the anterior and posterior margins finer than the others. Shell differing from that of *Cardita spurca* Sowerby in that it is smaller, thinner, and has finer ribs. Dimensions: length, 18.2 mm.; height, 15.5 mm.; convexity, both valves together, 11 mm.

HOLOTYPE (Calif. Acad. Sci. Dept. Geol. Type Coll.), dredged off Manzanillo, Colima, Mexico, in Lat. 19°24′00″ N., Long. 104°-22′00″ W., in 35 fathoms (55 meters), gravelly sand; collected during the Eastern Pacific ZACA Expedition, November 22, 1937.

The shell here described as a new subspecies was cited by Hertlein and Strong[1] under the name of *Cardita spurca* Sowerby[2], although it was realized at the time that the specimens varied somewhat from the original description of *C. spurca* and from Reeve's illustration of that species.

A comparison of the present shells from west Mexico with those of *Cardita spurca* from Chile leads the author to conclude that these thinner, smaller northern forms are sufficiently distinct to merit subspecific status and therefore the name *beebei* is proposed for them in honor of Dr. William Beebe, director of the Eastern Pacific ZACA Expedition of the New York Zoological Society during which the type specimen was collected.

This subspecies is known to occur in the region between Carmen Island in the Gulf of California and Punta Arena, Costa Rica, in 25-35 fathoms.

Ocenebra sloati Hertlein, new species
Plate 21, figures 8, 9

Shell of medium size, white, with seven whorls, the earliest portion of the apex eroded; second whorl nearly smooth but with traces of fine, raised, axial striae; third whorl broadly rounded and with two spiral lirae, one nearly medial, the other between it and the suture, these are crossed by axial lines similar to those on the second whorl; strong axial riblets begin to develop on the third whorl, about six on the succeeding whorls, increasing to nine on the last whorl; the later whorls are subtabulate and bear about three faint spirals on the tabulation, with the same strong spiral cords as on the earlier whorls but with the development of an intercalary thread between the major cords and one between the anterior one and the suture; the last whorl is sculptured with about a dozen concentric cords which become finer on the canal and in each interspace a fine intercalary thread is present; the entire shell is covered with fine axial imbricating lamellæ; columella sinuously curved; interior of inner and outer lips smooth; a small siphonal fasciole present. Dimensions: length, 19.4 mm.; maximum width, 11.3 mm.; height of spire approximately 8.6 mm.

HOLOTYPE (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 27587 (C.A.S.), dredged from off big rocks off Cape San Lucas, Lower California, Mexico, in 20-25 fathoms, during the Templeton Crocker Expedition of the California Academy of Sciences, August 6, 1932.

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[1]Hertlein, L. G. and Strong, A.M., Zoologica, New York Zool. Soc., Vol. 31. Pt. 3, No. 8, p. 106, December 5, 1946.

[2]*Cardita spurca* Sowerby, Proc. Zool. Soc. London for 1832, p. 195, issued March 13, 1833. "Hab ad oras Peruviae." "Dredged among coarse sand and gravel, in from six to ten fathoms, at Iquiqui, in Peru."—Reeve, Conch. Icon., Vol. 1, *Cardita*, species 32, pl. 7, fig. 32, 1843.

The shell of this new species differs from that of *Ocenebra foveolata* Hinds, a species well known in southern California, in that it is broader, the spire is shorter, the columella is more sinuous and the inner and outer lips are smooth in shells of comparable size. The present shells are wholly white rather than brown as in the species described by Hinds.

This species is named for Lewis Warrington Sloat, pioneer conchologist in California, one of the founders and the first secretary of the California Academy of Sciences.

Ocenebra sloati hambachi Hertlein, new subspecies
Plate 21, figures 10, 11

Shell with the general features of *Ocenebra sloati,* but with more rounded whorls, finer axial striae, and much finer, wavy, concentric sculpture. Dimensions: length, 21.3 mm.; maximum diameter, 10.6 mm.; height of spire, approximately 9 mm.

Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 27574 (C.A.S.), dredged about 47 miles southeast of Manzanillo, Colima, Mexico, Lat. 18°33′00″ N.; long. 103°45′00″ W., in 52 fathoms; Templeton Crocker Expedition of the California Academy of Sciences, July 17, 1932.

This subspecies is named for Dr. Gustav Hambach, whose library and collections in the California Academy of Sciences have been an invaluable aid in research work.

Acmaea strongiana Hertlein, new species
Plate 21, figures 1, 2

Shell small, thin, flattish, somewhat irregularly ovate in outline, the apex pointed, raised and situated at about the anterior fourth of the shell; the exterior surface grainy and irregularly ridged, the ground color is greenish-white with about six to seven broad, dark radial bands, and between these some fine radial irregular brown bands and spots; interior smooth, the black radial bands pronounced and separated by creamy-white to white bands, a brownish apical spot present, most pronounced posterior to the apex. Dimensions: length, 8.8 mm.; width, 6.2 mm.; height, 2 mm.

Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 34041 (C.A.S.), Pelican Point, Punta Peñasco, Sonora, Mexico; Mr. and Mrs. Harry R. Turver, collectors.

The irregularly ridged exterior surface and broad black radial bands on the exterior of the shell of the present species are features quite different from those of any species of *Acmaea* known to occur in west American waters. These features, as well as the broad, shiny black radial bands and creamy-white intervening areas so prominent on the interior of the shell, easily serve to separate it from species such as *Acmaea strigatella* Carpenter,

which occurs in the same area. The latter is ornamented externally by numerous, somewhat irregular whitish radial stripes, and the interior is white with brown flecks along the margin. The shell of *Acmaea stipulata* Reeve, which has a somewhat similar shape, differs in the possession of many coarse radial ribs exteriorly which denticulate the margin interiorly, and there are differences in color as well.

Fifteen specimens collected by the Turvers, six specimens collected by Mr. E. P. Chace, San Diego Society of Natural History,

Explanation of Figures on Plate 21

Fig. 1. *Acmæa strongiana* Hertlein, new species. Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 34041 (C.A.S.), Pelican Point, Punta Peñasco, Sonora, Mexico, Length, 8.8. mm.; width, 6.2 mm.; height, 2 mm. Apical view.

Fig. 2. *Acmaea strongiana* Hertlein, new species. Holotype. View of interior of specimen shown in Fig. 1.

Fig. 3. *Cardita spurca beebei* Hertlein, new subspecies. Holotype (Calif. Acad. Sci. Dept. Geol. Type. Coll.), from Loc. 17815 (C.A.S.), dredged off Manzanillo, Colima, Mexico, Lat. 19°24′00″ N., Long. 104°22′00″ W., in 35 fathoms (55 meters). Length, 18.2 mm.; height, 15.5 mm.; convexity (one valve), 5.5 mm. View showing interior of right valve.

Fig. 4. *Cardita spurca beebei* Hertlein, new subspecies. Holotype. View of interior of left valve.

Fig. 5. *Acmaea turveri fayae* Hertlein, new subspecies. Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from San Felipe, Lower California, Mexico. Length, 8.9 mm.; width, 7.6 mm.; height, 3 mm. Lateral view.

Fig. 6. *Acmaea turveri fayae* Hertlein, new subspecies. Holotype. Apical view.

Fig. 7. *Acmaea turveri fayae* Hertlein, new subspecies. Holotype. View of interior.

Fig. 8. *Ocenebra sloati* Hertlein, new species. Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 27587 (C.A.S.), dredged off big rocks off Cape San Lucas, Lower California, in 20-25 fathoms. Length, 19.4 mm.; maximum diameter, 11.3 mm.,

Fig. 9. *Ocenebra sloati* Hertlein, new species. Holotype. Another view of specimen shown in Fig. 8.

Fig. 10. *Ocenebra sloati hambachi* Hertlein, new subspecies. Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from Loc. 27574 (C.A.S.), dredged about 47 miles southeast of Manzanillo, Colima, Mexico, Lat. 18°33′00″N., Long. 103°45′00″W., in 52 fathoms. Length, 21.3 mm.; maximum diameter, 10.6 mm.

Fig. 11. *Ocenebra sloati hambachi* Hertlein, new subspecies. Holotype. Another view of specimen shown in Fig. 10.

Fig. 12. *Cardita spurca beebei* Hertlein, new subspecies. Paratype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from the same locality as the holotype shown in Fig. 3. Length, 17.9 mm.; height, 14.8 mm.; convexity (both valves together), 12 mm. View of anterior end.

Fig. 13. *Cardita spurca beebei* Hertlein, new subspecies. Holotype. View of exterior of right valve.

Fig. 14. *Cardita spurca beebei* Hertlein, new subspecies. Holotype. View of exterior of left valve.

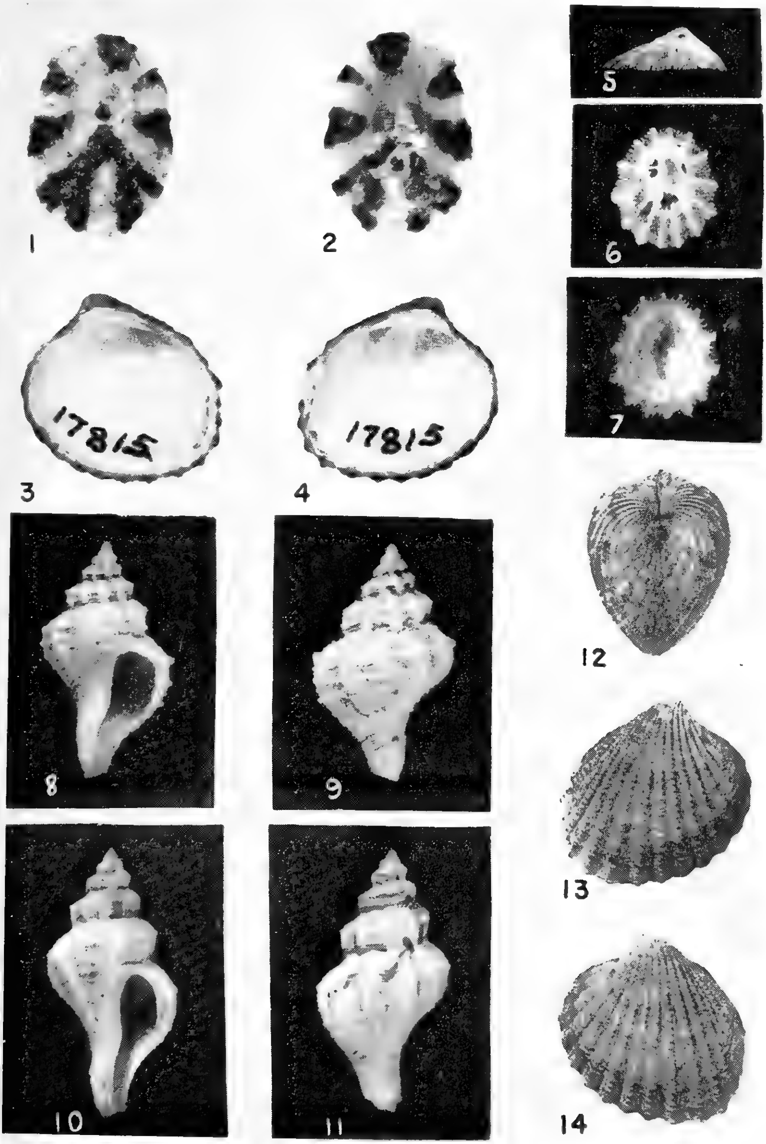

PLATE 21

and six collected near the type locality by Mrs. Faye B. Howard of Ocampo, California, have been available for study. The largest of these is 9.8 mm. in length. These shells appear to be quite different from the young of any known species and it appears that they are probably adult.

This new species is named for the late A. M. Strong, whose many contributions added so much to the knowledge of west American conchology.

Acmaea turveri fayae Hertlein, new subspecies

Plate 21, figures 5, 6, 7

Shell small, thin, ovate, moderately elevated, the apex situated decidedly anteriorly; sculpture consists of 14 rather fine, raised radial ribs; area between the ribs ornamented with ovate to elongately diamond-shaped areas formed by brown lines on a gray ground. Interior, opalescent white with traces of blue, the margin with fine brown dots separated by wider white areas corresponding to the ribs. Dimensions: length, 8.9 mm.; width, 7.6 mm.; height, 3 mm.

Holotype (Calif. Acad. Sci. Dept. Geol. Type Coll.), from San Felipe, Lower California, Mexico; Mrs. Faye B. Howard, collector. Two additional specimens are in the collection of Mrs. Howard.

The present shells bear a close resemblance to *Acmaea turveri* Hertlein & Strong[3], which also occurs in the northern portion of the Gulf of California, in coloration of both the exterior and the interior. They might be a variant of that species but the shells are more elevated and the radial ribs are decidedly finer than those observed on any specimens of *A. turveri.* In the character of the ribs they resemble that of *Acmaea conus* Test. In view of the uncertainty concerning the relationship of this form, the conservative course is followed and it is here described as a subspecies of *A. turveri.*

[3]*Acmaea turveri* Hertlein & Strong, Bull. South. Calif. Acad. Sci., Vol. 50, Pt. 3, p. 152, pl. 51, figs. 1, 2, 3, September-December (issued December 27), 1951. "Punta Colorado near Guaymas, Mexico."

ON CYCLOPHORID SNAIL SHELLS AND OPERCULA FROM GUERRERO AND YUCATÁN, MÉXICO.

By ROBERT J. DRAKE
Department of Zoology, University of Arizona

In the summer of 1955 Prof. George E. Fay of Southern State College of Arkansas, supported in part by Grant No. 1963 from the Penrose Fund of the American Philosophical Society, conducted an archæological survey in México (Fay 1956). He collected 45 lots of mollusk shells in 12 states and turned them over to the writer for disposition and possible report (Fay 1956: 321). Most of the specimens have been deposited in the University of Arizona Invertebrate Museum and due to current lack of documented comparative material and access to some of the earlier literature, the shells are being reported upon in connection with other studies in progress on inland mollusks of México and the American Southwest.

The writer has been engaged in making a record-locality summation of most of Northwest México (roughly the states of Durango, Sinaloa, Sonora, Chihuahua, and Baja California) since 1946 in anticipation of the need for such a basic work in the future when nonmarine molluscan remains are utilized more for supplying zoogeographic and climatic information concomitant to interdisciplinary attacks upon sediments of the times of the Pleistocene, the Recent, and archaeological Early Man in Western North America (Drake 1954: 357-360, 362-363).

At least one representative of the landshell family Cyclophoridae has been found in Sinaloa and as yet there are no records of the family, living or fossil, for the other states of Northwest México. The family is found in all tropic regions of the world and there is a New World history of it back at least as far as the Miocene of the West Indies; the operculate cyclophorids are different biologically from most of the inland mollusks of Western North America, having male and female animals instead of hermaphroditic reproductive systems in single animals, as in the other (and mostly pulmonate) landsnail families. The general habitat for cyclophorids seems to be leaf mulch ecology and thus of areas where there are (or were) wooded regions of greater or lesser expanses. Deforesting Man is their great enemy. Less than half a dozen genera are represented in Mainland North America and less than twenty species are known, several with four or five

morphological subspecies as have been defined (Solem 1956). The Cyclophoridæ is considered, and has been placed, close to other operculate families but of freshwater and marine dominions.

Among Prof. Fay's collecting in the west coast state of Guerrero were five not long dead shells of that cyclophorid occurring northwardly in Sinaloa, one with remnants of periostracum on the upper whorls and containing an operculum. Because of the interest in the species occurring within the arbitrarily defined Northwest México area, these shells are reported upon.

Personal exchanges in 1950 with Dr. Harold W. Harry and the University of Michigan Museum of Zoology contained cyclophorid shells from the state of Yucatán (from Dr. Harry's April 1948 fieldwork in connection with spring bird migration studies there of Mr. George Lowery, Jr.) and also from F. M. Gaige's 1930 collecting. The Yucatán specimens collected by Dr. Harry contained several shells with opercula and as the operculum for the subspecies is not illustrated in later publications (as it may be in older monographs), it is illustrated here. All specimens treated here have been deposited in the UAIM.

1. *Mexcylotus lutescens* (Pfeiffer) 1851.

Historical: In their monographic treatment of the American Mainland cyclophorids, Bartsch and Morrison (1942: 180-182) separated this species and *M. cooperi* (Tryon) (=*Cyclotus cooperi* Tryon 1863, from Mazatlán, Sinaloa). After examination of type material and study of additional lots of both, Solem (1956: 54-56) placed *M. cooperi* under *M. lutescens*. Plate 22 shows the west coast Mexican distribution of *lutescens* as given by Solem in 1956 and the location of the lot from Fay's collecting in Guerrero (as No. 6). Solem furthermore gives southernmost records from Costa Rica for *lutescens* (not shown on the map here) and added a third species (*M. petersi* from Michoacan) to the genus; its general location is shown as Nos. 9 and 10. The correct serial number of the holotype of *cooperi* reportedly is Academy of Natural Sciences of Philadelphia 13019, not 10019 as given by Bartsch and Morrison 1942, page 180 (Solem 1956: 55).

Guerrero Locality: Surface of archæological site G-4 (of Fay's site-numbering system for 1955) on the southeast bank of the Papagayo River, approximately 30 miles southeast of Acapulco. George E. Fay collector; 5 July 1955.

UAIM 123-a (shell with orange-tinted periostracum and containing an operculum behind a plug of soil in the aperture): Pl. 23, figs. 1-4; width, 12.4 mm.; height, 9.7 mm.; aperture width, 6.2 mm.; aperture height, 6.1 mm.; 4.5 whorls. UAIM 123-b (shell): Pl. 23, figs. 5-8; width, 18.3 mm.; height, 14.7; aperture width,

PLATE 22

Mexcylotus lutescens: 1, Mazatlán, Sinaloa; 2, Rosario, Sinaloa; 3, San Sabastián, Jalisco; 4, Ixtapan, Jalisco; 5, Zihuantanejo, Guerrero; 6, 1955 Fay survey site G-4, approximately 30 miles southeast of Acapulco, Guerrero; 7, state of Oaxaca. *Mexcylotus petersi petersi*: 9, La Placita (=Sulatillo), Michoacan. *Mexcylotus petersi damianensis*: 10, San Pedro Damian Narajestilla, Michoacan. *Neocyclotus dysoni berendti:* 8, Chichén Itzá, Yucatán.

9.1 mm.; aperture height, 9.3 mm.; 4.3 whorls. UAIM 123-c (shell): Pl. 23, figs. 9-10; width, 17.0 mm.; height, 13.4 mm.; aperture width, 8.6 mm.; aperture height, 9.4 mm.; 4.5 whorls. UAIM 123-d (shell): Pl. 23, figs. 11-12; width, 16.1 mm.; height, 13.0 mm.; aperture width, 8.5 mm.; aperture height, 8.9 mm.; 4.7 whorls. UAIM 123-e (damaged shell): width, *ca.* 15.0 mm; height, 11.3 mm.; 4.5 whorls. Ranges for UAIM 123: width, 12.4 mm. to 18.3 mm.; height, 9.7 mm. to 14.7 mm.; aperture width, 6.2 mm. to 9.1 mm.; aperture height, 6.1 mm. to 9.4 mm.; whorls, 4.3 to 4.7.

DISCUSSION: The five shells of lot UAIM 123 are basically described in the descriptions for *cooperi* and *lutescens* in the work of Bartsch and Morrison (1942: 180, 181). Features that seem characteristic, but not particularly diagnostic, are: a smooth nuclear whorl of slightly over one turn which is well-rounded and forms a distinct apex, four of the five shells are moderately high-spired with the fifth (123-a) going toward the others, the operculum is dished but not deeply so (being more like a shallow

saucer) and the ridges of the convolutions are in the concave side, the operculum is corneous and has at least 10 convolutions and the calcareous deposits among the ridges are heavy but scattered (Pl. 23, fig. 4), and the standing ridges of the convolutions have jagged and almost saw-toothed edges. There is no suggestion of a parietal notch in the aperture wall as in *M. petersi petersi* Solem 1956.

Solem's notes on opercula of the several *Mexcyclotus* he studied bring up interesting points and it seems worthwhile to quote them here: "The opercular series is even more striking [than the sculptural features]. In *M. lutescens* (Pl. 5, fig. 16) the operculum is quite flat, the edges of the volutions only slightly raised and with only a very thin layer of calcareous material between the opercular whorls. In *M. p. damianensis* the operculum (Pl. 6., fig. 18) is deeply dished, the edges of the volutions closely appressed and with a moderately heavy deposit of calcareous material between the opercular whorls. In *M. petersi* the operculum (Pl. 6, fig. 17) is secondarily flattened with a slightly sunken nucleus, the edges of the volutions free and ragged and with very heavy calcareous deposits between the opercular whorls." (Solem 1956: 57).

Could opercular cross-sections such as flat or deep-dished, and forms of the projections of the convolutions possibly point to sexual differences? Or, even differences scattered throughout the populations without too much correlations with other morphological features such as minor differences in skin, hair form, teeth, etc. as in mammals? Perhaps too, as the cyclophorids are old geologically, opercular differences are only relicts without much physiological or anatomical meaning. When the biology of this group of landsnails is better known, morphological differences probably can be understood in terms of what we know and obviously don't know of specialization now; or, the old saw of a reproducing kind and variation, and, of course, what constitutes a species.

It is comforting to see thought-provoking works such as those of Morrison (1955) and Solem (1956) appear on this family of cyclophorids hardly a decade after the sizable summation of Bartsch and Morrison in 1942. If other nonmarine family groups could be treated as extensively, other fields would have much more, much sooner, to draw upon when utilizing the mollusks in regional and biological and paleoenvironmental projects of research.

2. Notes on *Neocyclotus dysoni berendti* (Pfeiffer) 1861.

Bartsch and Morrison (1942: 212-213) placed this form in the genus *Aperostoma*. Harry who collected the operculum illustrated, (Pl. 23, figs. 14-15) did likewise (1950: 25-26). Solem (1956: 53)

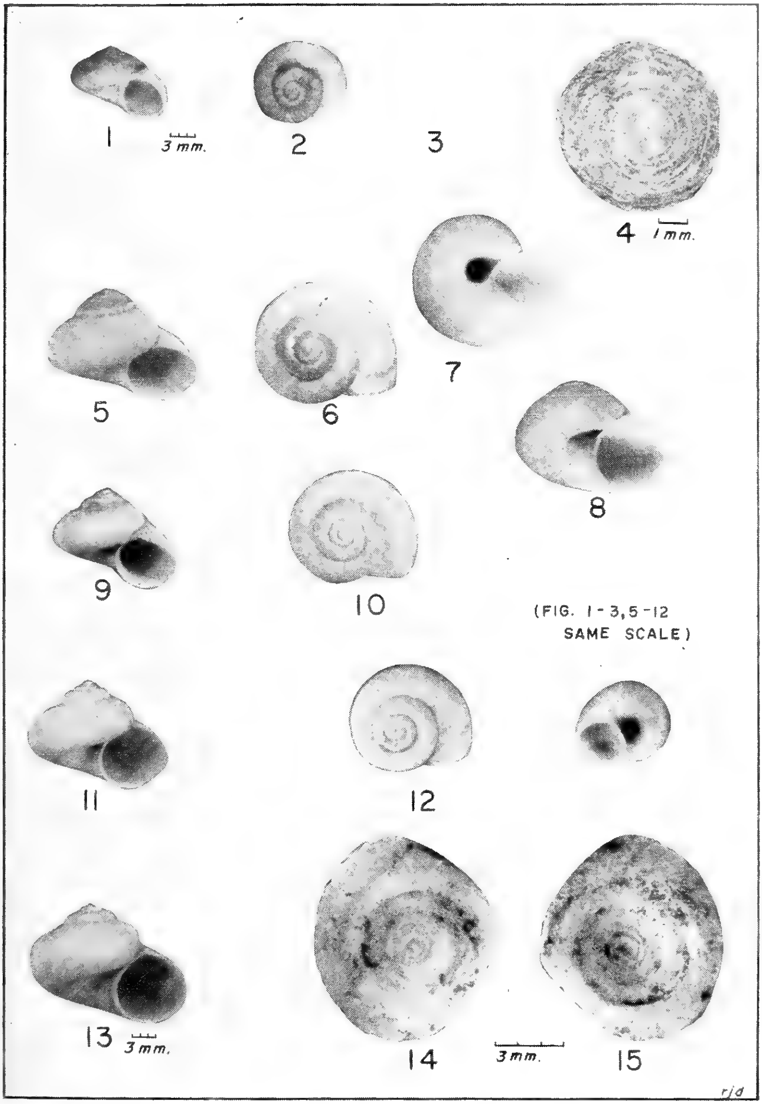

PLATE 23

Figs. 1-12. – *Mexcyclotus lutescens* (Pfeiffer), Guerrero.
Figs. 13-15.–*Neocylotus dysoni berendti* (Pfeiffer), Yucatán.

referred the species back to *Neocyclotus* but did not illustrate shell or operculum. The illustrations of Bartsch and Morrison (Pl. 29, figs. 4-6) are of shells only. Illustrated are sides of an operculum from a dead shell from Dr. Harry's collecting on 27 April 1948 from his Station 6 (Harry 1950: 5) which was 8 miles northwest of Chichén Itzá on the road to Mérida in the state of Yucatán; it is UAIM 337-a. The shell illustrated (Pl. 23, fig. 13) is from Chichén Itzá and was collected by F. M. Gaige in early 1930; it is UAIM 338-a. Shells from Harry's collecting were deposited as Drake Molluscan Collection 1601 and Wendell O. Gregg Collection 5948; shells from the Gaige collecting were deposited as DMC 1602 and WOG Coll. 5949. The shell illustrated, UAIM 338-a, measures: width, 19.8 mm.; height, 15.4 mm.; aperture width, 9.5 mm.; and, aperture height, 10.0 mm.

(This paper was prepared with help from a Bache Fund grant in 1957. Background material was from data gathered with help of previous Bache, Penrose (American Philosophical Society) and Permanent Science Fund grants from 1951 to 1954.)

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NOTES ON THE AMPHIPOD GENUS *ORCHESTOIDEA* ON THE PACIFIC COAST OF NORTH AMERICA

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The amphipod genus *Orchestoidea* presently contains eleven species of burrowing shore-dwelling Talitridæ of which six (including the present new species) have been recorded from the Pacific coast of North America and one each from the coasts of El Salvador, Costa Rica, Chile, Brazil, and southern Europe. The type species is *O. tuberculata* Nicolet 1849 known only from the vicinity of Valparaiso and the coast of Chile. The genus is defined essentially as "like Talitrus, except that gnathopod 2 in the male is powerfully subchelate instead of feebly chelate" (after Stebbing, 1906). In the writer's opinion this statement is insufficient to delimit the genus. It does not diagnose other characters (e.g. of mouthparts, antennae, peraeopods, pleosome, urosome, etc.,) that are of accepted generic value within the Talitridae, and implies incorrectly that, in all other generic respects, species of *Orchestoidea* are like *Talitrus saltator* (Pallas). As Norman (1900), Reid (1947), and others have suggested, certain characters of the gnathopods (gamopods) that have long been relied upon as generic criteria in the land-dwelling Amphipoda are frequently indefinite even at the specific level. Continued acceptance of these criteria without cognizance of other major taxonomical differences has contributed mainly to the present unsatisfactory situation at the generic level. Appropriate examples of this situation are: (1) the failure of Stebbing (1899) to ascribe his *Talorchestia tridentata* to *Orchestoidea pugettensis* (Dana), (2) the difficulty of Shoemaker (1932) in generically placing *Talorchestia fritzi* Stebbing, and (3) Hurley's decision (1955) to synonomize *Talitrus* and *Talitroides*. In attempting to come to grips with this problem Norman (1900) has suggested that the European *Talorchestia brito* Stebbing and *T. deshayesi* Audouin be transferred to the genus *Orchestoidea*, and Derzhavin (1937) has described a large sand-burrowing talitrid from the far-eastern coast of the U. S. S. R. as *Orchestoidea trinitatis**. Both Norman and Derzhavin concluded that the presence of a distal ventral tubercle on segment 6 of gnathopod 1 in the male does not form a true palm against which the finger closes and thus does not comply with the generally accepted meaning of the term "subchelate". However, these three species are not referable to the genus *Orchestoidea* as it is presently known from America chiefly because of the different type of pleopods, and, in the case of the

European species, because of differences in the relative lengths of peraeopods 4 and 5, and the unlike condition of uropod 3.

Although these and other major differences in the burrowing terrestrial Talitridae should be formally recognized, a revision of the genera is beyond the scope of this short paper and would require considerably more study. At the present time, however, it seems desirable to delimit more fully the genus *Orchestoidea* on characters of generic value common to several species of the group. The writer has recently examined material of *O. tuberculata*, the generic type, kindly supplied by Dr. H. E. Grüner. Characters of generic value in this species, particularly those described and figured by Bate (1862) and Stebbing (1906) apply reasonably well to the six North American species at hand, although somewhat less well to *O. meridionalis* Schuster (1954) from El Salvador and *O. biolleyi* Stebbing (1908) from Costa Rica. *O. brasiliensis* (Dana) 1853 is much more highly adapted for terrestrial sand-burrowing existence than are species from the Pacific coast of the New World. Special modifications of the head and third peraeopods and extreme reduction of antenna 1 and pleopods in both sexes (illustrated by Schellenberg, 1938) may prove of generic significance. The writer agrees with Schellenberg that *O. fischeri* (Milne-Edwards) 1828, recorded from Greece, Spain, and South Africa is quite unlike American members of the group and is doubtfully of this genus.

The writer gratefully acknowledges the material supplied and assistance rendered in the preparation of this report by Dr. J. L. Barnard, Allan Hancock Foundation, and Mr. W. L. Klawe, Scripps Institute of Oceanography.

Genus *Orchestoidea* Nicolet 1849

Diagnosis: Peraeon fairly broad, typically smooth; pleon compressed, tapering posteriorly. Head rather deep, depth greater than length; eyes typically large, subrotund. Antenna 1 short, reaching about the middle of penultimate segment of peduncle of antenna 2; antenna 2 rather long, powerful; segment 1 of peduncle longer than segment 3, spinose on outer face; segment 4 about half the length of segment 5; flagellar segments with or without teeth.

* Synonomized by Gurjanova (1951) with the sandhopper complex of Northern Japan and the Kuriles, earlier ascribed by Iwasa (1939) and Stephensen (1944) to *Talorchestia brito* Stebbing 1891.

Mouth parts much as in *Talitrus* and *Talorchestia;* palp of outer plate of maxilla 1 very small, 2-jointed; inner plate of maxillipeds armed terminally with three subequal spine-teeth; maxilliped palp of four segments, the first three broadly expanded and heavily spinose on the inner margin, the fourth very small and nearly obscure.

Gnathopod (gamopod) 1, propod and dactyl simple in male and female, usually strongly developed; in male, distal ventral tubercle usually prominent but sometimes lacking on segment 5, variable but usually small or lacking on segment 6; coxa bearing a small median plate, lower margin armed with longish spines.

Gnathopod 2 powerfully subchelate in the male, weakly chelate ("mitten-like") in the female; segment 2 more or less expanded in female, front and hind margins with small spines; posterior lobe on segment 4 variously developed or absent. Peraeopods 1-5 stout, heavily spinose; peraeopod 2 shorter than peraeopod 1, dactyl of 2 with strong basal prominence; peraeopods 3-5 with second segment greatly expanded posteriorly, dactyl long; peraeopod 3 much shorter than peraeopod 4; peraeopod 5 not longer than peraeopod 4.

Branchial vesicles borne medially on the coxæ of peræon segments 2-6 inclusive, increasing in size posteriorly; brood lamellae on segments 2-5 inclusive, smallest on segment 2, marginal setae rather short and straight.

Pleopods more or less reduced, posterior pair smallest; peduncle more or less basally expanded, both margins armed with spines, a pair of minute coupling spines distally on inner margin; rami not longer than peduncle, subequal, segments variously fused and armed with spines and plumose setae.

Urosome segments 2 and 3 very short, telescoping dorsally with segment 1; uropod 1 longer than uropod 2, both armed posteriorly with strong spines on peduncle and rami; uropod 3, ramus and peduncle subequal, heavily spinose; ramus laterally compressed and rounded at the tip.

Telson small, dorsally spinose.

Key to the North American Pacific Species of *Orchestoidea* (both sexes and immatures)

1. Antenna 2, flagellum not shorter than peduncle; uropod 2, inner margin of outer ramus armed with stout spines; gnathopod 2 in male, palm of segment 6 nearly regularly convex; gnathopod 2 in female, posterior lobe of segment 4 large, prominent, projecting at right angles to posterior margin 2

   Antenna 2, flagellum shorter than peduncle; uropod 2, inner

margin of outer ramus unarmed; gnathopod 2 in male, palm of segment 6 with large pointed spinose tooth; gnathopod 2 in female, posterior lobe of segment 4 small, projecting distally at an acute angle 4

2. Antero-ventral margins of abdominal side plates 1 and 2 armed with small spines; rami of pleopods less than half the length of the peduncle; inner ramus armed terminally with only 1-3 plumose setae; animal large. .... *O californiana* (Brandt).
   Antero-ventral margins of abdominal side plates smooth; rami of pleopods ½-¾ the length of the peduncle; inner ramus armed terminally with four or more plumose setae; animals small 3

3. Posterior margin of abdominal side plates 2 and 3 almost smooth; rami of pleopods each with 4-7 plumose setae; posterior process of gnathopod 2 moderately developed in both sexes; inner margin of outer ramus of uroped 2 unarmed distally .... *O. columbiana* Bousfield
   Posterior margin of abdominal side plates 2 and 3 armed with 4-8 small spines; rami of pleopods each with 7-11 plumose setae; posterior lobe of gnathopod 2 strongly developed in both sexes; inner margin of outer ramus of uropod 2 with spines throughout .... *O. minor* n. sp.

4. Antero-ventral margin of abdominal side plate 1 armed with 2-5 spines; proximal part of peduncle of pleopods little expanded; rami each with 6-9 plumose terminal setae .... *O. pugettensis* (Dana)
   Antero-ventral margin of side plate 1 smooth; peduncle of pleopods expanded basally; rami each with only 2-5 plumose setae .... 5.

5. Posterior margin of abdominal side plates 1-3 lined with 10 or more small spines; mature animals relatively large (15-22 mm.) .... *O. corniculata* Stout
   Posterior margin of abdominal side plates with only 1-5 small spines; mature animals small (9-13 mm.) .... *O. benedicti* Shoemaker

Synopsis of North American Species of *Orchestoidea.*

1. *Orchestoidea californiana* (Brandt) 1851 (Plate 24)

syn: *Orchestoidea californiana* Stebbing 1906, p. 528
O. pugettensis Stebbing 1906, p. 529 (female)
O. californiana Stout 1913, p. 647, 648, figs. A. B.
O. californiana Ricketts and Calvin, 1952, p. 192

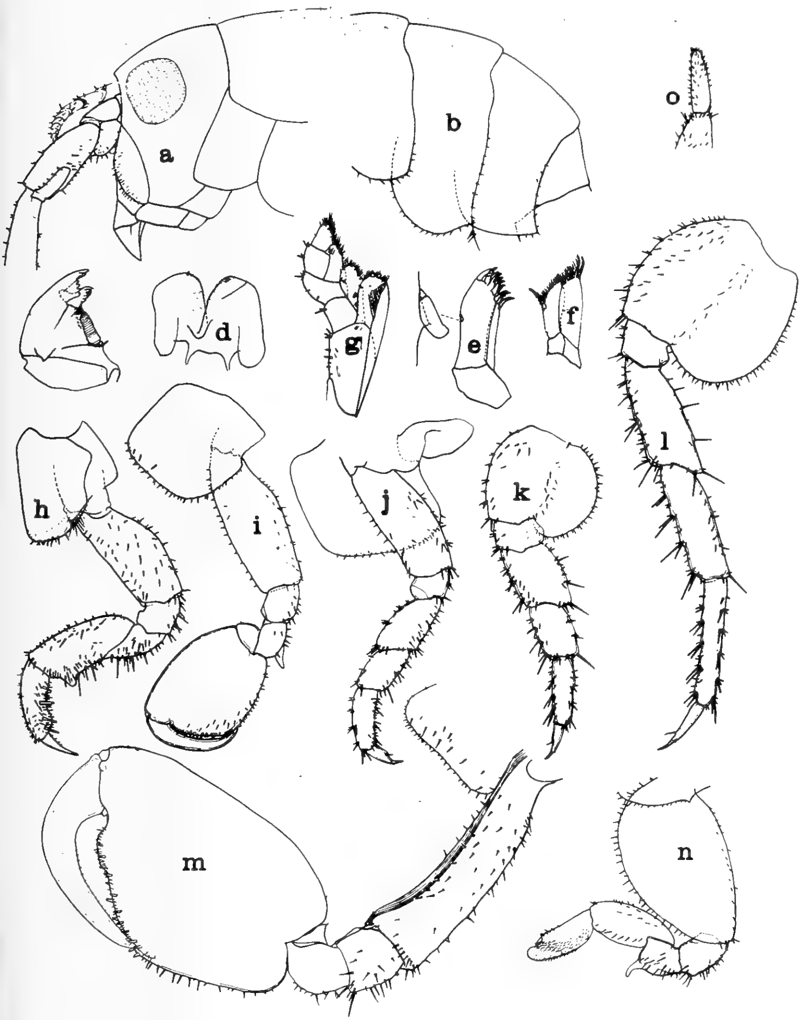

PLATE 24

Orchestoidea californiana (Brandt), Dillon Beach, California. Male (15mm.): (a) head region (b) pleosome (c) left mandible (d) lower lip (e) maxilla 1, palp enlarged (f) maxilla 2 (g) maxilliped (h) gnathopod 1 (i) gnathopod 2 (j) peraeopod 2 (k) peraeopod 3 (l) peraeopod 5; Male (33 mm.): (m) gnathopod 2; Female (23 mm.): (n) gnathopod 2 (o) uropod 3.

The following description and figures of *O. californiana* have been included for comparison with the closely similar new species *O. minor:*

Antenna 1, flagellum of 6-9 segments; antenna 2, flagellum longer than peduncle, in males as long as body, with more than 25 segments. Maxilliped palp, first three segments broadly expanded, 3rd about as long as wide, 4th very small, obscured by terminal spines of 3rd, bearing terminal spines (not shown in plate 24).

Gnathopod (gamopod) 1 of male, ventral process prominent on segment, 5, scarcely discernible on segment 6, dactyl long and strong.

Gnathopod 2 of 15 mm. male, segment 4 with posterior lobe, palm of segment 6 smoothly convex, dactyl smoothly curved; in 33 mm. male, segment 4 without posterior lobe, palm of segment 6 with low truncated prominence near hinge, dactyl sharply curved, approximating palm only at tip; in mature female, segment 2 broadly expanded anteriorly, posterior lobe prominent but not large, segment 5 gently convex above and below.

Peraeopods 1-5 typical of the genus.

Paired genital papillae of male borne ventrally on peraeon 7, small, outer face with a few median spines, aperture slit-shaped.

Pleosome, small spines lining posterior margin of side plates 1-3, antero-ventral margins of 1 and 2, and part of ventral margin of 3; pleopods decreasing in size posteriorly; peduncle basally expanded, spines on outer margin stronger than on inner; rami less than half the length of the peduncle, inner ramus bearing 1-2 plumose setae, outer ramus with spines and 4-7 plumose setae. Urosome, segments 2 and 3 very short, telescoping dorsally into segment 1; posterior spines of rami of uropods 1 and 2 very long and tapering on outer margins but relatively small and weak on inner margins.

Telson spade-shaped, broader than long, very slightly emarginate at the tip.

Material:

Charleston, Coos Bay, Oregon, beach south of station line, J. L. Mohr coll., Aug 17, 1950. – 5 males, 13 females.

Dillon Beach, Marin Co., Calif.; sandy shore at HW line; author coll., July 17, 1955. – 22 males, 16 females (6 ovig.)

Piedras Blancas, San Luis Obispo Co., Calif., J. L. Mohr coll., March 31, 1947. – 1 male, 1 female, 1 imm.

Pismo Beach, Calif; under algae on strand, medium coarse sand; J. L. Barnard & D. J. Reish coll., Dec. 27, 1955. – 1 male, 1 female.

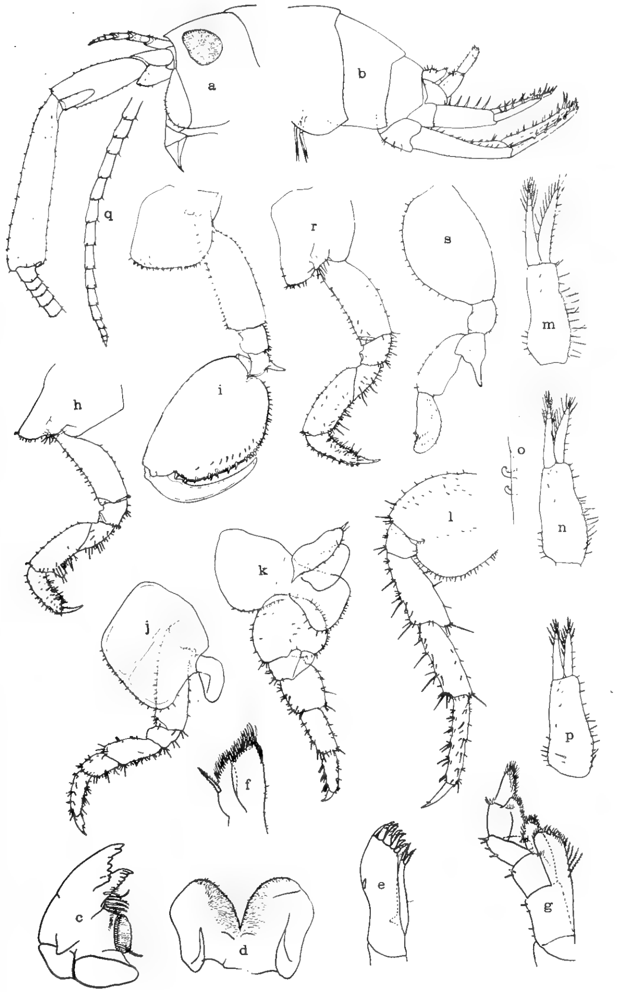

PLATE 25

Orchestoidea minor n. sp., Point Dume, California. Male (14 mm.): (a) head region (b) pleosome and urosome (c) left mandible (d) lower lip (e) maxilla 1 (f) maxilla 2 (g) maxilliped (h) gnathopod 1 (i) gnathopod 2 (j) peraeopod 2 (k) peraeopod 3 (l) peraeopod 5 (m) pleopod 1 (n) pleopod 2 (o) coupling spines of pleopod 2 (p) pleopod 3 (q) distal segments of flagellum of antenna 2; Female (15 mm.): (r) gnathopod 1 (s) gnathopod 2.

Previously recorded from northern California, Oregon (Barnard, 1954), Washington (Thorsteinson, 1941), and British Columbia (Bousfield, 1957 in press). Not yet recorded south of Laguna Beach, California.

2. *Orchestoidea columbiana* Bousfield 1957 in press.

Previously recorded from outer and inner coasts of Vancouver Island, British Columbia.

3. *Orchestoidea minor* n. sp. (plate 25)

Description: Eye subrotund, relatively small in alcoholic specimens, about half the width of the head.

Antenna 1 short, flagellum 5-6 segmented; antenna 2 long, as long as body in mature males, flagellum longer than peduncle, 22-25 segmented, flagellar teeth small; penultimate segment of peduncle about half the length of the ultimate segment, both armed with numerous short spines.

Mouthparts about normal; maxilliped palp, 3rd segment somewhat longer than wide, narrowing distally; 4th segment small and obscured by terminal spines or 3rd (not shown in plate 25).

Gnathopod 1, dactyl strong, not quite half the length of the well developed propod; in male, ventral tubercle prominent on segment 5, weakly developed distally on segment 6.

Gnathopod 2, in female, segment 2 greatly expanded anteriorly, little posteriorly; posterior lobe on segment 4 present in both sexes, very large and prominent in female; segment 5 of female convex above, shallowly concave below; segment 6 of male very large, oval, anterior margin smoothly convex, posterior margin nearly straight and lined with short spines; palm with slight prominence near hinge, obliquely curving to the posterior angle, demarcated from posterior margin by several spine teeth; dactyl gently curving, inner margin with fine spinules and indented near hinge, tip closing in groove at posterior angle.

Peraeopods typical of the genus, dactyls not unusually long.

Pleosome side plates 1-3, antero-ventral margin smooth, posterior margins of 2-3 lined with 5-8 small spines. Pleopods decreasing posteriorly in size and degree of armature; peduncle somewhat expanded basally, strong spines basally on inner margin and along entire outer margin; paired coupling spines similar; rami ½ to ¾ the length of the peduncle, outer ramus with 1-2 terminal segments and armed with several spines and 9-11 plumose setae, inner ramus with 2-4 terminal segments and armed with 0-3 spines and 7-10 plumose setae.

Urosome segments 2 and 3 very short, telescoping dorsally into segment 1; uropods 1 and 2 typical, inner margin of outer ramus of uropod 1 without spines; uropod 3 dorsally and laterally spinose, rami and peduncle subequal.

Telson small, spade-shaped, almost as wide as long, cleft slightly at the tip.

LENGTH: Male holotype – 14 mm.; female allotype – 15mm.

TYPES: Allan Hancock Foundation No. 5010, male holotype, female allotype, 2 female cotypes (none ovigerous).

TYPE LOCALITY: Pt. Dume, L.A. Co., Calif., coarse sand beach, Aug. 10/50, coll. J. L. Barnard.

ADDITIONAL MATERIAL: Playa del Rey, L. A. Co., Calif.; under *Macrocystis* wrack on sandy beach, J. L. Barnard coll., June 24, 1955 – 6 males, 7 females (none ovig.); largest specimen 11 mm.

Ensenada, lower California, Mexico; under seaweed at HW line of sandy beach; W. Klawe, June 3, 1956 – 1 female (subadult).

REMARKS: The species is superficially like *O. californiana* but is much smaller, hence the specific name. It is very close to *O. columbiana*, particularly in the general form of the gnathopods of both sexes; distinguished mainly by its less broadly pigmented eyes, relatively elongate 3rd joint of the maxilliped palp, and stronger armature of antenna 2, abdominal side plates, pleopods and uropods.

4. *Orchestoidea benedicti* Shoemaker 1930, p. 112, fig. 3.

syn: *Orchestoidea benedicti* Ricketts and Calvin, 1952, p. 157.

MATERIAL:

Dillon Beach, Tomales Bay, Marin Co., Calif.; burrowing at HW level of sandy beach; author coll., July 17, 1955 – 2 males.

Pismo Beach, Calif.; under algae on strand, medium coarse sand; J. L. Barnard and D. J. Reish coll., Dec. 27, 1955 – 1 male, 11 fem., 7 juv.

Ensenada, Lower California, Mexico; under sea weeds, just above the HW line of a sandy beach; W. L. Klawe, June 3, 1956 – 1 male, 12 fem., sev. imm.

Previously recorded from Pacific Grove, Anaheim Bay, La Jolla, and San Diego, California (Shoemaker, 1930).

5. *Orchestoidea corniculata* Stout 1913, p. 647-650, fig. C.

syn: *O. corniculata* Ricketts and Calvin, 1952, p. 157.

MATERIAL:

Redondo Beach, Los Angeles Co., Calif. (no other data); in collections of the Royal Ontario Museum of Zoology, Toronto – 1 male.

Corona del Mar, L.A. Co., Calif.; coarse sand behind rock, intertidal; J. L. Barnard coll., March 28, 1953 – 5 males, 2 females (ovigerous).

Pt. Loma, San Diego, Calif.: rock beach; W. L. Klawe coll., Feb., 1956 – 3 females (sub-adult), 2 imm.

Previously recorded from Laguna Beach (Stout, 1913).

6. *Orchestoidea pugettensis* (Dana) 1853, p. 859, pl. 57, fig. 3a-d.
syn: *Talorchestia tridentata* Stebbing 1899, p. 398, plate 30B (male)
Orchestoidea pugettensis Thorsteinson, 1941, p. 54, pl. I, figs. 1-9 (male)
non Orchestoidea pugettensis Stebbing 1906, p. 529 (female)
Orchestoidea corniculata Thorsteinson, 1941, p. 55.

Previously recorded from Washington (Thorsteinson, 1941) and British Columbia (Bousfield, 1957, in press). By kind permission of Mr. C. R. Shoemaker, U. S. National Museum, the writer has examined Thorsteinson's material of *O. corniculata* from Pt. Roberts, Wash., and found it to be *O. pugettensis* (Dana).

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A NEW GENUS OF DEXAMINID AMPHIPOD (MARINE CRUSTACEA) FROM CALIFORNIA*

By J. Laurens Barnard

*Contribution No. 202 from the Allan Hancock Foundation, University of Southern California

The family Dexaminidae is composed of 25 species in 8 genera. An excellent key to the genera was constructed by Sheard 1938 and the following new species would fit the genus *Dexaminoides* Spandl in Sheard's key. However, examination of the literature on the single species of *Dexaminoides* shows the present species to have a number of distinctive features, which are the subject of the following new names.

I am indebted to Dr. Olga Hartman for bringing specimens of this species to my attention and the Allan Hancock Foundation for use of space and equipment.

Family DEXAMINIDAE

Dexamonica, new genus

Diagnosis.-Dexaminid with small cephalic rostrum, article 2 of antenna 1 shorter than article 1, maxilliped palp with 4 articles, maxilla 1 palp with one article, maxilliped with bud-like inner plate; female antennae short; mandibular processes of lower lip short, blunt, inner lobes moderately well developed, party fused, peraeopods short, the fifth shorter than the third and fourth.

Remarks.-This genus is like *Dexaminoides* but peræopod 5 is stout and shorter than peraeopods 3-4; article 4 of the maxilliped palp is short and blunt, not claw-shaped; the mandibular processes of the lower lip are blunt and scarcely attenuated, the inner plates narrow and partially fused; the antennae of the female are very short and of the same length.

The new genus differs from all others in the family by the combination of the short fifth peraeopod and the small inner plate of the maxilliped.

Dexamonica reduncans, new species

PLATES 26, 27

Descriptive features.-Eyes medium in size, lenses few in number; antenna 2 of female very short, article 5 shorter than 4; mandible with large molar, accessory plate present; upper lip with rounded lower edge; lower lip with outer lobes apically acute but not prolonged; inner plate of maxilla 1 with apical setule and fused spine; outer edge of outer plate of maxilla 2 with only one seta.

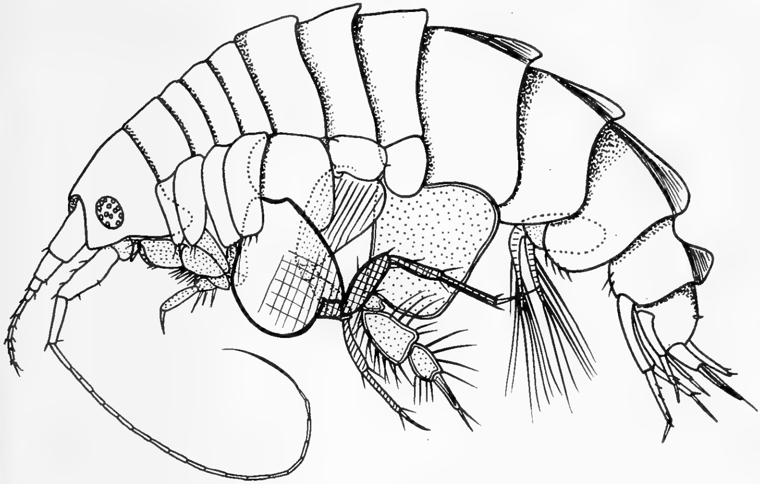

PLATE 26

Dexamonica reduncans, n. gen. n. sp.
Lateral view of male, 2.3 mm, sta. 3491-55.

Coxae 1-2 narrowing apically, gnathopods 1 and 2 similar. Dactyls of all peraeopods each with a distal spine.

Uropods 1-2 with large distal spines on rami; uropod 3 small in female and rami armed with a few spines. Telson cleft nearly to base, not elongated, each lobe triangular.

Dorsal part of body from peraeon segment 5 bearing a medial carina which increases in size to pleon segment 3 and is acutely produced behind on each segment except pleon 3; pleon segment 4 with a retruse carina in female; fused pleon segments 5-6 bear one or more dorsal spines.

MALE.-Differs from the female by the longer and setose rami of uropod 3; antenna 2 more than half as long as body; pleon segment 4 bears a pyramidal carina.

HOLOTYPE.-Allan Hancock Foundation No. 551, ovigerous female, 2.0 mm.

TYPE LOCALITY.-Station 3491-55, Santa Monica Bay, California. 33° 52′ 41″ N, 118° 28′ 04″ W, 31 fms, on bottom of green mud, Sept. 15, 1955.

MATERIAL EXAMINED.-Stations 3491-55 (35), 4753-56 (2), 4814-57 (1).

REMARKS.-The sample of 35 specimens contained 9 adult males, 2 juvenile males, 20 females without eggs and 4 females with one, two, three and five eggs respectively, the animals ranging in size from 2.0 to 2.5 mm.

The species has been collected at Pt. Conception, Santa Monica Bay and San Diego to depths of about 50 fms but has been rarely encountered in more than 600 samples examined by the writer along the coast of southern California.

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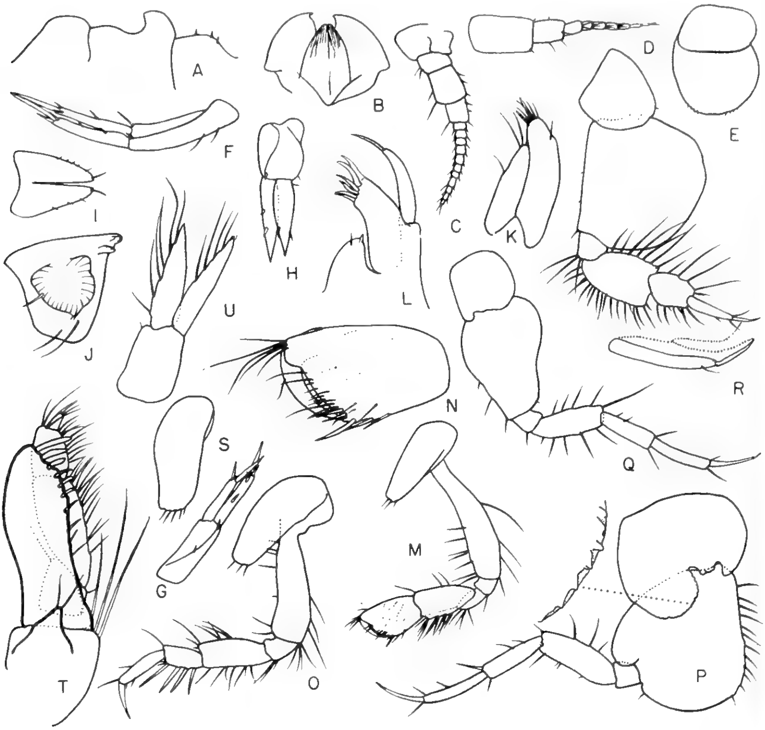

PLATE 27

Dexamonica reduncans, n. gen. n. sp.

Female, 2.0 mm, sta. 3491-55.

Fig. A, dorsal view of pleon segments 3, 4, (5-6); B, lower lip; C, D, antennae 2, 1; E, upper lip; F, G, H, uropods 1, 2, 3; I, telson; J, mandible; K, L, maxillae 2, 1; M, gnathopod 1; N, hand of gnathopod 1; O, P, Q, R, peraeopods 1, 3, 4, 5; S, coxa 4; T, maxilliped.

Male, 2.3 mm, sta. 3491-55.

Fig. U, uropod 3.

THE ACT OF MOLTING IN THE CALIFORNIA XANTHIDAE, THE PEBBLE CRABS

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This paper deals with the molting act of the major species of California Xanthidae, the pebble crabs. The xanthid crabs are typically of tropical waters and are represented in California by only five genera. Of these only *Lophopanopeus, Cycloxanthops* and *Paraxanthias* are common, the other two genera are either highly restricted or absent at this time. Hiatt (1948) has made the only extensive study of the molting act of a species of our west coast Brachyura in his paper on *Pachygrapsus crassipes.* This paper, together with that of Pearson (1908) and Williamson (1903) on *Cancer Pagurus* and of Drach (1939) on *Maia squinado,* will serve as a basis in comparing ecdysis of this heretofore unknown group of California crabs. Material used in this study consisted of xanthid crabs caught in the field just prior to ecdysis and maintained at the Allan Hancock Foundation, University of Southern California. Although the drawings in this paper are of *Cycloxanthops novemdentatus,* the data presented applies to all three major genera unless otherwise indicated.

Frequently molting is thought of as synonomous with growth as stated by Olmsted and Baumberger (1923), "growth at other times (than ecdysis) is impossible because of the nature of the exoskeleton." However, this is not the case. Ecdysis is merely an expression of growth completed, and a necessary act to allow the continuance of growth. The case is more accurately stated by Herrick (1909), "the crustacean does not grow by molting,—but molts because it has grown." "Two phases may be used to describe this otherwise continuous process: (1) a passive phase of skeletal salt resorption and imbibition, and (2) an active phase in which inbibition and muscular activity combine to unsheathe the animal."

Some behavioristic changes may be noted prior to the time of molting. *Cycloxanthops novemdentatus* are found to migrate inshore in the months of April through June (where a sloping bottom topography permits such a migration). These individuals remain at the plus-six-inch tide level until ecdysis is complete and the new shell is hard enough to grant protection. At that time

they migrate to deeper water to spend the summer. Both *Cycloxanthops novemdentatus* and *Lophopanopeus spp.* build small grottoes with seaweed under a pile of rock. The weed is used to plug the entrances to their little rooms, and perhaps for food after ecdysis. Salter (1860) observed that the European lobster, *Homarus vulgaris*, collected algae into piles in which it hid after molting. Hay (1905, for *Callinectes sapidus*) and Hiatt (1948, for *Pachygrapsus crassipes*) noted a decrease in activity just before molting which may also correspond to the withdrawal of the Xanthidae.

Xanthid crabs do not eat for several days before molting. Confined animals refused food, and an examination of many exuviae and post-molt animals shows the stomach to be empty.

Many Crustacea show distinct color changes before molting (Braun, 1875; Churchill, 1918; Drach, 1939; Eimhirst, 1923; Herrick, 1896; Hiatt, 1948) due to salt resorption and a detachment of the new integument from the old. The California Xanthidae do not display any such change due to their thick, opaque exoskeleton. However, one color sign may be used to tell if the xanthid crabs are about to molt or if they have completed molting. Just after ecdysis the "fingers" of the chelae are crimson-red or orange-brown. With age the "fingers" turn darker and become black prior to ecdysis. Newly molted *Cycloxanthops novemdentatus* are generally bright red all over, but turn to a dark purple before molting. Salt resorption begins several days before molting and continues up to the beginning of the passive phase. Resorption occurs chiefly along the epimeral line, the basi-ishial and meral segments of the chelae, and the endosternite-endopleurite junction of the eighth through twelfth arthrophragms. The exoskeleton does not become fragile before ecdysis as is the case of some grapsoid crabs, (Olmsted and Baumberger, 1923; Hiatt, 1948).

The passive phase of ecdysis begins when the epimeral line becomes desclerotized and splits, allowing the carapace to raise above the epimeron (Plate 28, Figures 1 and 2). The split generally begins on the day of ecdysis, starting posteriorly and proceeding anteriorly to the oral area. The carapace is slowly raised as a result of the increasing haemocoelic fluid pressure. As the carapace elevates, the new integument becomes visible underneath (Plate 29, Figures 2 and 6). The passive phase continues until the carapace is elevated about twenty degrees. During this time the crab is active and appears very restless. It moves about, frequently changing from one hiding place to another, and it often tries to escape from the aquarium. Its reflexes are very quick. The crab is constantly on the defensive, displaying its chelae if antagonized. When handled, however, it makes no attempt to pinch with the chelae even though it maintains the defensive "bluff."

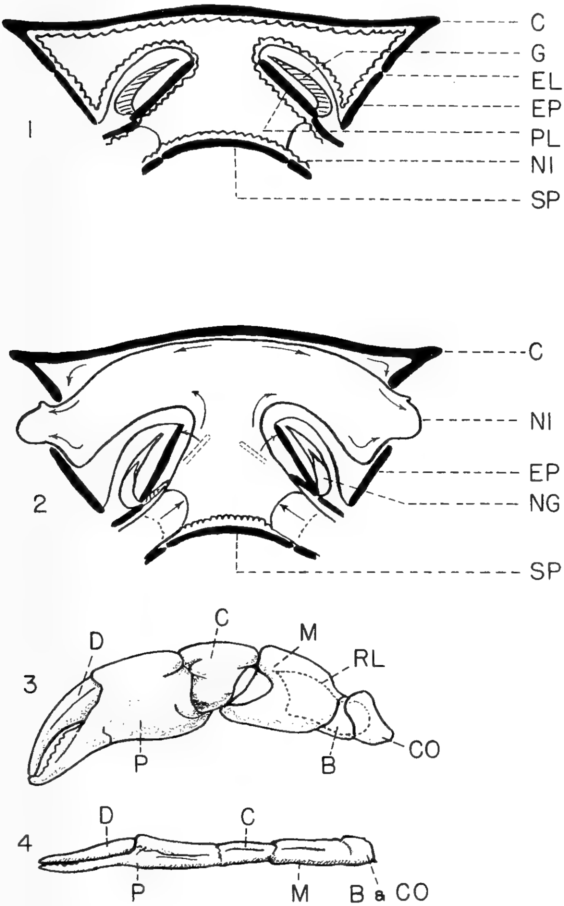


PLATE 28

Figure 1. A diagrammatic cross section of a xanthid crab just before ecdysis. C, old carapace; G, gill; EL, epimeral line; EP, epimeron; PL, pleural wall; NI, new integument; SP, sternal plaston.

Figure 2. A diagrammatic indication of expansion during ecdysis. Symbols as in Figure 1.

Figure 3. An anterior aspect of a chela showing the resorption line. D, dactylus; P, propodus; C, carpus; M, merus; B, basi-ischium; CO, coxa; RL, resorption line.

Figure 4. A chela just after ecdysis. Symbols as in Figure 3.

Plate 28, Figures 1 and 2, shows the course of expansion (arrows) of the new integument as the carapace is elevated. The new integument (Figure 1) is wrinkled beneath the old exoskeleton. As the carapace is raised the new integument slips out between it and the epimeron, and not under the epimeron as illustrated by Drach (1939) and Hiatt (1948).

The end of the passive phase is seen when alternate depressions occur on either side of the cardiac area of the new carapace. The depressions are the results of muscle contractions in the basal segments of the pereiopods. Many of these muscles are inserted on the endopleurites and the pleural wall. Muscles also connect the pleural wall with the new carapace. Thus the muscle actively employed to help unsheathe the pereiopods is reflected on the cardiac area. The depressions (leg muscle contractions) occur on alternate sides at intervals of four to ten seconds for about five to seven minutes.

The pereiopods are moved, simulating a jerky, running action just prior to the beginning of the leg-muscle contraction. This running motion may last as long as one minute and probably serves to loosen the new leg-integument from the old exoskeleton. While these activities are under way, the new carapace swells with increased rapidity. The whole surface rises and falls in a simulated breathing movement. The areas of swelling are chiefly concentrated in the cardiac area and the two lateral, branchial areas. As the old carapace is raised even higher, (Plate 29, Figures 3 and 7) the lateral margins of the new carapace slip under the edge of the old carapace, thus allowing a fuller and more rapid expansion. At this time the abdomen and pereiopods begin to unsheathe. The posterior edge of the body is lifted upward and backward, exerting pressure on the abdomen and legs. The legs expand and contract alternately as they are unsheathed. While watching the process of ecdysis from a dorsal view it is seen that the crab rotates from side to side as it moves backwards. The rotation is simultaneous with leg-muscle contraction and is probably due to that phase of activity.

The abdomen is the first part of the body to be free from the old exoskeleton. This is unlike the lobster (Herrick, 1896, 1909; Eimhirst, 1923), which first frees the cephalothorax, and then the abdomen. The description of ecdysis of *Pachygrapsus crassipes* given by Hiatt (1948) states that the legs are first removed from the exoskeleton and after this the abdomen. This is a physical impossibility, since the abdomen is shorter than the legs and has its origin behind the fourth pair of walking legs. As the body is elevated posterodorsally the abdomen must be freed first. Hiatt's statement is probably an error of phrasing rather than of observation.

As the abdomen becomes free (Plate 29, Figures 4 and 8), the

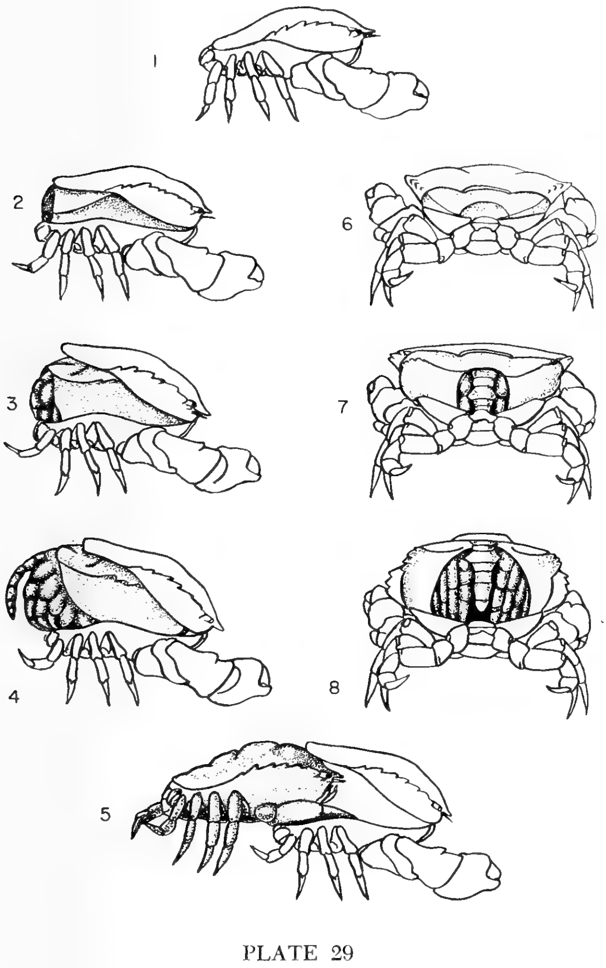


PLATE 29

Figure 1. Lateral view of a xanthid crab prior to the passive phase of ecdysis.

Figures 2 and 6. Lateral and posterior views of a xanthid crab at the end of the passive phase of ecdysis.

Figures 3 and 7. Lateral and posterior views of a xanthid crab early in the active phase of ecdysis, showing the "new" abdomen and pereiopods.

Figures 4 and 8. Lateral and posterior views of a xanthid crab near the end of the active phase of ecdysis.

Figure 5. Lateral view of a xanthid crab at the end of the active phase.

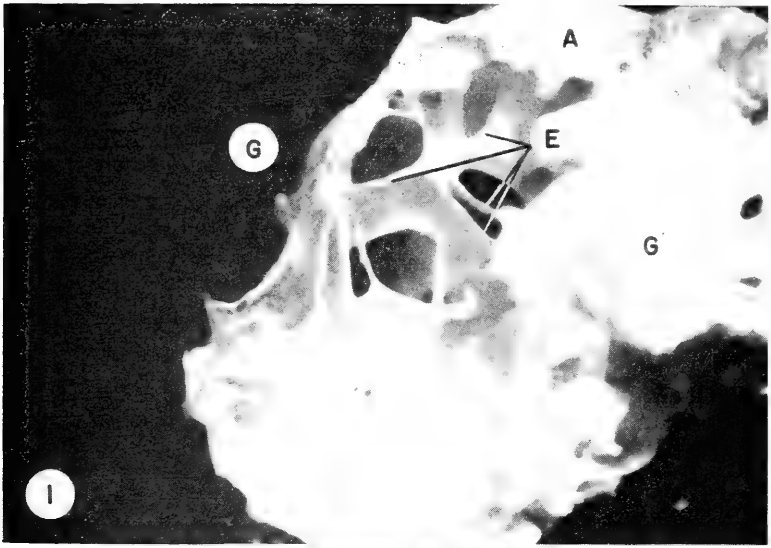
major effort is exerted on the walking legs. The last pair of legs are removed first, followed by the third, second, and first pairs. As each pair is released it is flexed and exercised, and quickly takes its shape as it becomes turgid.

At this point the animal may rest or may complete ecdysis without any delay. The large "hands" of the chelipeds, the mouthparts, and stomach lining still remain to be unsheathed. Two things aid in unsheathing the chelipeds through their very small basal segments. First, there is an area where salts are removed (Plate 28, Figure 3, RL) on the meral and basi-ishial segments. This area seldom breaks free of the chela but can be pushed out to allow the "hand" to pass by. Secondly, the valve at the breaking plane closes and does not permit haemocoelic fluid to enter the chelæ until after ecdysis is complete. Plate 28, Figure 4, shows the right cheliped of *Cycloxanthops novemdentatus* just after it had been removed from the old shell. The entire length of the structure is shriveled up and very soft to the touch. The expansion of the chelipeds may take place in a few seconds or up to two hours after ecdysis.

As the chelae are slipped free the weight of the body protruding from the old shell, plus pressure produced by the pereiopods, helps to free the mouthparts, antennae, and other appendages. As the crab backs out of the old exoskeleton (Plate 29, Figure 5) the stomach-lining, tendons of the mandible muscles and many other structures are drawn out of the new body. In like manner the entire length of the intestinal lining which lies in the abdomen is also drawn out of the new body.

The "endoskeleton" of the xanthid crab is formed of a complicated series of plates which serve as places of muscle origin. The plates of chief concern (Plate 30, Figure 1, E) in ecdysis are those in the thoracic part of the body which lie transversely between the median plate, the sternum, and the pleural wall. They consist of double-layered infoldings between the sternites and pleurites. The new integument which will ultimately form the endosternites and endopleurites is folded on each side of the old skeletal unit. After it has been drawn away, leaving the old unit behind, the two new surfaces unite to form a new double-walled body partition. The endopleurite-endosternite partitions are further united on their dorsal surfaces so that molting is impossible. However, a comparison of an exuvium (Plate 30, Figure 2) with a normal endoskeleton (Figure 1) shows that a great deal of the skeletal salts have been removed. The endoskeleton at the time of ecdysis is then greatly reduced and easily gives way as the body is extracted.

The gills which are attached to the new pleural wall are drawn out of their old covering and through a small opening at the base



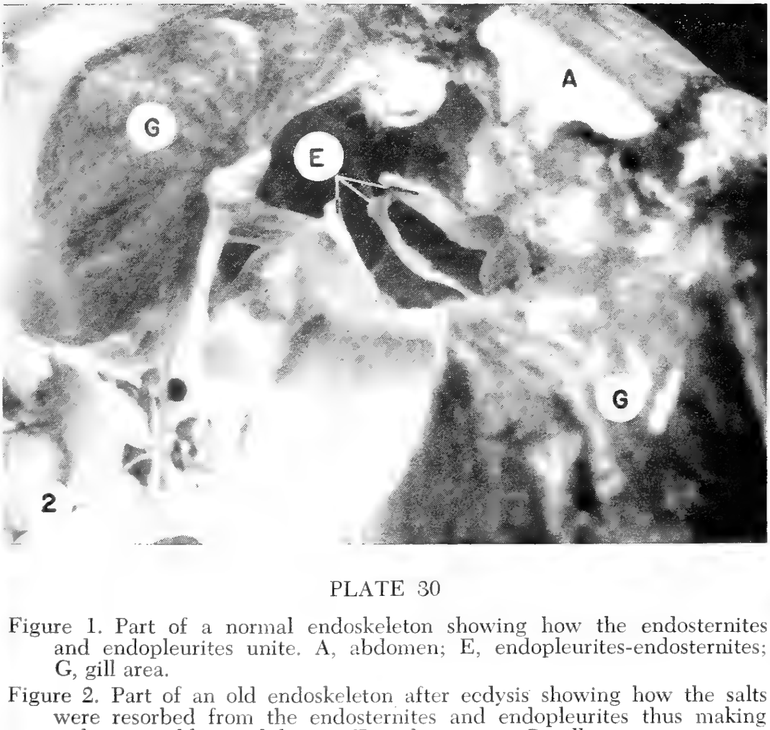


PLATE 30

Figure 1. Part of a normal endoskeleton showing how the endosternites and endopleurites unite. A, abdomen; E, endopleurites-endosternites; G, gill area.

Figure 2. Part of an old endoskeleton after ecdysis showing how the salts were resorbed from the endosternites and endopleurites thus making ecdysis possible. A, abdomen; E, endosternites; G, gill area.

of the old pleural wall. The dorsal lifting of the carapace and extraction of the legs causes the new pleural wall to migrate dorsally (Plate 28, Figure 2), which automatically unsheathes the new gills. It was noted that the old mouthparts continuously pump water through the gill chamber until they are finally unsheathed. The new mouthparts begin the flow of water again in just a few seconds' time after the molting act is completed. Hiatt (1948) recorded sixty-one deaths of *Pachygrapsus crassipes* during ecdysis in the laboratory. Of these 73.2 per cent died while the gills were only partly unsheathed. Of thirty-three cases of xanthid ecdysis in the laboratory there were only three fatalities; none of these occurred while the gills were being unsheathed. However, Hiatt's information suggests this to be one of the critical times of ecdysis.

The present writer has seen several "molting accidents" which are of interest. On a few occasions weakened crabs delayed the final extraction of the walking legs too long, so that the subsequent enlargment made further unsheathing impossible. On another occasion a *Lophopanopeus l. leucomanus* completed ecdysis successfully but did not back completely out of the old shell before resting. As the new carapace expanded, the eyes became caught in the lateral margins of the old carapace and trapped the crab. Another crab failed to get the gills on the right side of its body into the "pleural cavity." Thus the gills were exposed and were quickly injured. A last, rather unnatural case occurred when the covering of a regenerated leg was removed a few days before ecdysis. When the haemocoelic fluid was pumped into the new appendage it caused it to expand before being withdrawn from the old skeleton. Hence, it was necessary to autotomize the appendage before the crab could free itself from the old exoskeleton.

It is imperative that the active phase of ecdysis be carried out swiftly so that the animal does not become entrapped by premature expansion, die from gill malfunction, or be attacked by enemies. Of the Xanthidæ observed, the time required for this phase was from five to twelve minutes. This time compares very well with that required by other Brachyura, as does the entire process of ecdysis. Broekhuysen (1941), Hiatt (1948), and McKay (1942) have noted that most of their captive specimens molted at night. This is also true for the Xanthidae of California. The writer has collected a great many newly molted xanthid crabs between the hours of 2:00 A.M. and 7:00 A.M. The sense receptors of these animals are very keen after ecdysis. One such crab defensively extended its chelae when the writer reached down to touch it even though defense at such a time was impossible. It was noted that the pereiopods are turgid enough to enable the crabs to walk or to bury themselves as soon as the molting act is completed. Thus the animals can further protect themselves from the danger of being discovered by another predator. On three

occasions, however, crabs of the species *Pachygrapsus crassipes* were found feeding on soft shelled xanthid crabs which they had killed.

The final expansion of the new carapace requires from thirty minutes to two hours after ecdysis. During this period the crab remains very inactive. In the days to follow, the activities are very much reduced. The crab tends to resort to the freeze response rather than to the Aufbaumreflex. In extreme danger the chelae are used to push things away from the body, but no attempt to use the claws is made until ten to twelve days have elapsed.

SUMMARY

1. *Cycloxanthops novemdentatus* migrates inshore to molt where the bottom topography will permit. *Cycloxanthops novemdentatus* and *Lophopanopeus* build grottoes in which to molt.

2. The "fingers" of the chelae are crimson-red to orange just after ecdysis, but darken and become black prior to the next molt.

3. The passive phase of molting begins with salt resorption and ends when the carapace is raised by the hæmocoelic fluid pressure to a height of about twenty degrees, at which time muscular activity is noted about the cardiac area.

4. The active phase of molting begins when muscular movement together with the swollen condition of the body unsheathes the crab, beginning with the abdomen and proceeding forward, freeing the mouth parts, chelae, and stomach lining last.

5. Salts are removed from the endoskeleton before molting can occur.

6. Molting probably occurs most frequently at night.

7. Many accidents apparently occur during molting when the process of unsheathing is interrupted while expansion is continued.

8. *Pachygrapsus crassipes* were found to kill and feed upon newly molted xanthid crabs.

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AN UNDESCRIBED SHORE-BUG FROM MANITOBA (HEMIPTERA, SALDIDAE)

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Smithsonian Institution, Washington, D.C.

The present paper characterizes a new saldid of the genus *Micracanthia* Reuter (1912) from Churchill, Manitoba, Canada. The type is deposited in the Canadian National Insect Collection, Ottawa, Canada.

Micracanthia ripula, new sp.

Small, black, slightly shining, the hemelytra blackish fuscous, somewhat velvety, dull, with pale markings as noted with structures;

head, pronotum and scutellum clothed with grayish brown, short pubescence, the hemelytra with a mixture of short, dark fuscous and flattened, golden pubescence. Body beneath black, with grayish pubescence. Length 2.75 mm.; width 1.20 mm.

Head slightly depressed between eyes, with a rounded amber spot between each ocellus and an eye, with a median, impressed, longitudinal line in front of ocelli; large apical callosities of frons, swollen clypeus and laminae maxillaris flavotestaceous; ocelli feebly elevated, separated from each other by about half the diameter of an ocellus. Labium very long, dark fuscous, shining, extending between hind coxae. Antennae slender, dark fuscous with first two segments testaceous, segment III and IV very little thicker than II, more densely clothed with short grayish pubescence than I and II, measurements – I, 0.25 mm.; II, 0.40 mm.; III, 0.30 mm.; IV, 0.38 mm. Eyes blackish.

Pronotum 0.80 mm. long, 1.12 mm. wide across humeral angles, there twice as wide as at collar; explanate margins moderately wide, with lateral margins feebly rounded; callus moderately large, moderately elevated, with a large, deep, discal impression, separated from collar in front and from posterior lobe behind by deep transverse furrows, each with a row of tiny pits in the bottom; collar short, slightly constricted; posterior lobe widely deeply excavated behind, about two-thirds as long as callus. Scutellum very little elevated, slightly wider at base than long (62:65), transversely impressed across middle, the triangular hind lobe finely transversely rugulose.

Hemelytra extending beyond apex of abdomen, with apices overlapping and jointly rounded in repose; clavus dark fuscous, with or without a pale apical spot; inner corium concolorous with clavus, without markings, the outer corium also dark velvety fuscous with both basal and apical parts testaceous; embolium testaceous with narrow base and a marginal apical spot blackish; membrane slightly brownish or fumose, divided into four long cells, each cell with one or two dark brown or fuscous spots. Legs testaceous with a wide, subapical band on each femur dark fuscous, bands sometimes not very distinct on inferior surfaces; middle and hind tibiae with several long, slender, dark fuscous spines; second tarsal segment feebly shorter than the third in all legs.

HOLOTYPE (male) and two paratypes (males), Churchill, Manitoba, Canada, August 10, 1935, collected by Dr. W. J. Brown.

Separated at once from *M. humilis* (Say) and *M. quadrimaculata* (Champion), both of which inhabit southern Canada, by the very short, flattened, golden pubescence. There are also differences in antennal measurements and color markings of hemelytra.

NOTES ON THE *CICINDELA PRÆTEXTATA* – *CALIFORNICA* TIGER BEETLE COMPLEX. DESCRIPTION OF A NEW SUBSPECIES FROM DEATH VALLEY, CALIFORNIA (COLEOPTERA - CICINDELIDÆ)

by NORMAN L. RUMPP

China Lake, California

This is written for the purpose of contributing further data to our growing knowledge of the Southwestern United States tiger beetles. This study attempts to establish a more fundamental systematic separation between *Cicindela prætextata* and *Cicindela californica* as it redefines the distribution of these species. At the subspecific level the following is proposed:

1. That the tiger beetle described as *Cicindela californica erronea* Vaurie (1950 : 8) from Willcox, Arizona, and the very similar tiger beetle discovered in Death Valley, California (Rumpp 1956 : 131) are not the same; that, in fact, they are allopatric siblings that belong to separate species. This conclusion is based in part on differences in the primary sexual characters of the internal sac of the male copulatory organ.
2. That the Death Valley tiger beetle is a new subspecies of *Cicindela californica* to be known henceforth as **Cicindela californica pseudoerronea,** new subspecies.
3. That the Willcox tiger beetle is not a subspecies of *Cicindela californica,* as reported, and should be known henceforth as *Cicindela prætextata erronea* Vaurie, new combination.

ACKNOWLEDGMENTS

Many thanks are due Dr. Mont A. Cazier for the donation of samples of ssp. *erronea,* including a paratype, and the exchange of valuable information. Sincere appreciation is expressed for the kind assistance of Mr. Lloyd M. Martin of the Los Angeles County Museum in arranging for the loan of material. Mr. Hugh B. Leech of the California Academy of Sciences supplied specimens and loaned important literature for which the author is grateful.

HISTORICAL BACKGROUND

C. californica Ménétriés 1854, and *C. prætextata* LeConte 1854 were described in the same year as separate species. When LeConte wrote his revision of the Cicindelæ (1857: 27-62) he considered *C. prætextata and C. circumpicta* as closely allied species, but completely misplaced the relationship of *C. californica* because he had only seen a sketch of the latter's elytral maculation. C. W. Leng

(1902: 171-172) in his review of the Cicindelidae chose to include both under *C. circumpicta,* basing his decision on superficial characters common to all three. T. L. Casey in his Memoirs (1913: 11, 33) thought these were distinct species, however his knowledge of *C. californica* seems to have been very limited. W. Horn in his checklist of the Cicindelidæ (1930) made allowance for specific differences between *C. californica* and *C. circumpicta,* but maintained that *C. praetextata* was a "lesser form" of *C. californica.* It was not until recently that M. A. Cazier (1954: 288) reported reproductive isolation between *C. prætextata* and *C. californica,* establishing from this observation the first proof of specific difference. Today *C. californica* and *C. prætextata* are accepted as distinct species; though some confusion still exists at the subspecific level.

At the time ssp. *erronea* was described *prætextata* was still considered subspecific to *C. californica,* which necessitated placing *erronea* under that species. In the original literature (Vaurie 1950: 1) the dissimilarity — rather than the close relationship — between ssp. *erronea* and ssp. *prætextata* was brought out. A bright green and blue tiger beetle discovered in Death Valley, California, in 1954 was recorded as equivalent to ssp. *erronea* (Rumpp 1956: 131). It will be shown that these conclusions are erroneous, and this, by coincidence, makes the name of the tiger beetle even more appropriate than originally intended.

ORIGIN, SEPARATION AND DISTRIBUTION

The work of E. Rivalier (1950: 217-244) and Helga Papp (1952: 492-533) on the Cicindelæ demonstrates clearly that the internal sac of the male copulatory organ can be used effectively as a positive classification factor. In a later paper on the American fauna (1954: 249-268) Rivalier indicates that *C. californica* and *C. circumpicta* can be grouped under the *Habroscelimorpha* Dohktourow, of which *C. dorsalis* is the type species.

The internal sacs of *C. prætextata* and *C. circumpicta* are of similar design and closely related to the *dorsalis* type. The rather long sac is encircled by a flagellum that traces a short clockwise whorl or loose spiral from the dorsal side[1] where it originates to the ventral side, thence another 90 degrees at the upper half where it sustains a membrane. This flagellum is fairly short, falciform, flattened into a ribbon at the lower half, and slightly expanded in the spiral that it describes from the ventral side to its base; this is illustrated on Plate 31, fig. f.

The internal sacs of *C. californica* and the related western species *C. gabbi* are of the same elongated form. In these the flagellum is

[1] The dorsal side of the penis is defined as the side that is viewed from the dorsal side of the insect when the elytra are parted, and when the penis is retracted within the body.

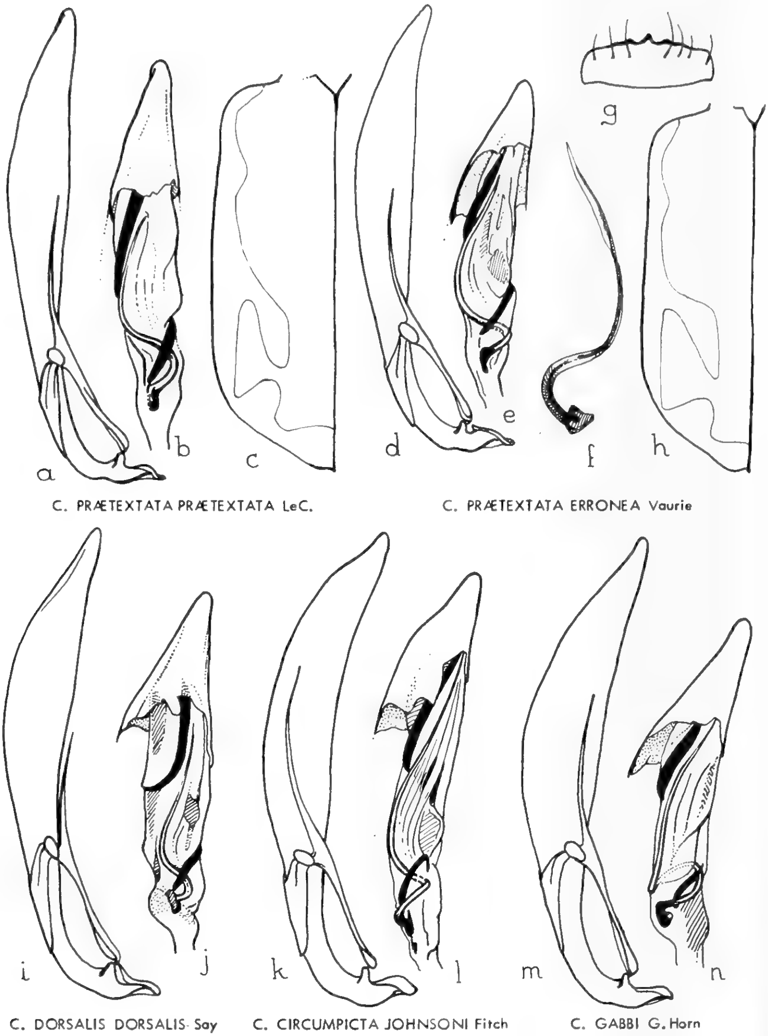

PLATE 31

Cicindela prætextata group compared to other allied *Cicindela.* Male copulatory organ, internal sac, and elytral marking. Figs. f. and g. of flagellum and labrum of *C. prætextata erronea.*

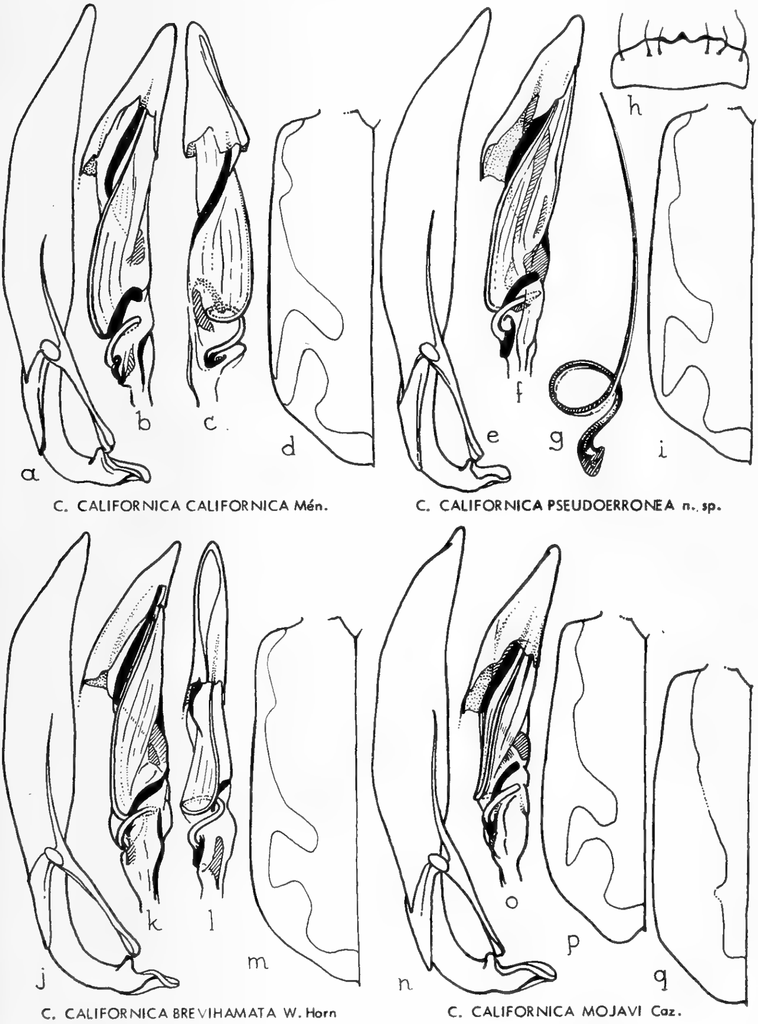

PLATE 32

Cicindela californica subspecies—Male copulatory organ, internal sac, and elytral marking. Figs. g. and h. of flagellum and labrum of *C. californica pseudoerrona.*

much longer, and more intricate in that it makes a complete loop that encompasses well over 360 degrees. The loop, while helicoidal, is nearly perpendicular to the axis of the sac, as shown on Plate 32, fig. g. There is only a slight flattening of the flagellum near its base. This structural specialization of the flagellum is so atypical as to have originated before the Pleistocene period; possibly at a time when important geological changes effectively separated these species from the main ancestral group.

Many of the Southwestern tiger beetles have varying numbers of subspecies that have developed as a result of relatively rapid changing environmental conditions. These conditions were particularly accelerated during the Pleistocene period. Following the various glacial advances there were post-pluvial times during which a steady drying up of the available surface water of the region caused disrupted concentrations around which some species had to readjust. Complex changes in the hydrographic connections between systems had a deep effect on the ecology of these species. In attempting to adjust to all these changes the isolated populations developed variations in color, maculation, and size from which more or less distinct subspecies may be recognized. By investigating this type of tiger beetle it is possible to obtain some correlation with recent geological history, to the extent that hypotheses can be advanced as to their former paths of dispersal with a fair chance of being accurate. *C. californica* and *C. willistoni* belong to this group. On the other hand the more ecologically tolerant tiger beetles, such as *C. hæmorrhagica*, cannot be studied with respect to these details. They are so well adapted to the conditions that prevail in the Southwest that they will disperse fortuitously whenever a new favorable condition arises.

On the assumption that Rivalier's regrouping of the *Habroscelimorpha* is correct, then the distribution of the species is confined mostly to the southern United States, Mexico, and Central America. These species nearly circumscribe the Gulf of Mexico, and inhabit the islands therein. While they do not populate the north shore of South America, they do spread northward along the Atlantic coast of the United States to Rhode Island. An offshoot branch populates the upper Sonoran Region, reaching as far as the shores of the Gulf of California, the Mojave – Colorado Deserts, and the Pacific coast of Southern and Baja California.

Cicindela prætextata is distributed in the Rio Grande system and the tributaries of the Colorado River. It reaches from southern Utah to the southern valleys of Arizona, and from western Texas to the lower Colorado River at Yuma, Arizona. It is present at the Salton Sea in California. *C. prætextata* is a distinct and polytypic species. This discussion will concern itself only with ssp. *erronea*.

1. *C. prætextata erronea* is found exclusively in the basin of ancient Lake Cochise in southeastern Arizona. It discloses a case of

entrapment dating at least from an "earlier" pluvial period. There is no evidence that Lake Cochise was ever connected to the Gila River, or even the Yaqui River, in pluvial times (Hubbs and Miller 1948: 115). The divides that now separate Lake Cochise basin from these river systems are low enough to allow fortuitous dispersal, however this is not occurring, either because of effective isolation, or because the exchange rate is so low and infrequent as to be absorbed; adaptability to a special environment may also be a factor.

The presence of ssp. *erronea* around a saline lake bed is an exception rather than a rule with *C. prætextata*. This may explain the striking bright green and blue color of this subspecies as compared to the reddish bronze color of the other subspecies. To reach this state of development required long isolation in this environment, and this long period of time correlates remarkably well with the recorded isolation of Lake Cochise.

The distribution of *Cicindela californica* is restricted to the perimeter of the Gulf of California, the Salton Sea region, the Mojave Desert, and Death Valley. This species always frequents tidal marshes and saline lake shores. It is found at low elevations, from sea level to about 1000 feet (Koehn Lake, California, is the only known location where it reaches an elevation of 1900 feet), and below sea level at the Salton Sea (–235 ft.) and Death Valley (–260 ft.). This discussion will concern itself with the two subspecies found in the United States.

1. *C. californica mojavi* of the Colorado River delta region is characterized by a bronze color that is slightly tinged with green, and a broad maculation that tends to be confluent. It is present at Cholla Beach, Sonora (Vaurie 1953: 80) and San Felipe, Baja California (Cazier 1954: 289), and by the Salton Sea in Imperial and Riverside counties, California. It probably spread northward along the Colorado River banks from where it reached the Mojave River basin by way of an early pluvial discharge (Hubbs and Miller 1948: 90). It is possible and most likely that it reached the type location at Koehn Lake, Kern county, California, from the Mojave River region either through lake discharge (Hubbs and Miller 1948: 88), fortuitously over low divides, or by short flights across stream headwaters. The typical population is characterized by a maculation that is nearly always confluent, and a high percentage of green and blue individuals. It is now entrapped in the Koehn Lake basin with little or no hope of further dispersal under present conditions. The separation of the Koehn Lake population from the population of the upper Gulf of California coast since an early pluvial time accounts for the differences in width of maculation between the two groups.

2. *C. californica pseudoerronea* has a bright green and blue color and a reduced maculation. This indicates a long and isolated tenure in Death Valley, where tiger beetles show a trend toward such de-

velopment. The presence of *C. californica* along the Mojave River in pluvial times does not account for the Death Valley subspecies since this would be predicated on ssp. *pseudoerronea* being directly derived from ssp. *mojavi*. It is unlikely that ssp. *pseudoerronea* reached its present state of development since the time of the relatively recent pluvial flow of the Mojave River into Death Valley. A still "earlier" connection with the Gulf of California is indicated.

At Soda Lake in San Bernardino county, near Baker, California, there is a hybrid population of *C. californica mojavi* X *pseudoerronea*. Individuals of this population are bright green and blue except for 15% that are bronze with only a greenish tinge. Their maculation is broad to confluent. Their size is smaller than either ssp. *pseudoerronea* or ssp. *mojavi*, measuring on the average 10.0 mm for males and 10.9 mm for females, based on sample sizes of 16 for each sex.

Soda Lake is the present sump of the Mojave River. The lake bed is normally dry except for a few small spring fed areas at the western edge. Around these areas four or five species of *Cicindela* may be found. The location of this lake is some distance north of the probable early pluvial discharge of the Mojave River into the Colorado River; it is, however, in the direct path of a chain of lakes through which the Mojave River discharged into Death Valley in pluvial times. The hybrids at Soda Lake most likely represent a cross between bronze, confluently maculated, residual *mojavi* populations left along the Mojave River, and green, narrowly maculated *pseudoerronea* stock from Death Valley. This argument leads to a conclusion that favors the isolation of the Death Valley populations from a time that predates the known Mojave – Colorado River connection.

The gradation in color that is apparent from Death Valley to Koehn Lake is caused by dilution of the typical ssp. *mojavi* as a result of this recent contact with ssp. *pseudoerronea* at the discharge end of the pluvial Mojave River lake chain. This is borne out by the fact that typical ssp. *mojavi* from Koehn Lake are 40% green or blue, whereas ssp. *mojavi* from Mexico and the Salton Sea are all bronze or greenish bronze.

DESCRIPTION OF TYPE

Cicindela californica pseudoerronea, new subspecies

Medium size, slender, bright green and blue. HEAD – green on top, clypeus and sides blue; labrum provided with six setæ, front margin feebly tridentate, median tooth acute; eyes prominent; front with numerous shallow longitudinal striæ; vertex lightly wrinkled; joints three and four of the maxillary palpi pigmented, second joint pigmented only on the dorsal side. PROTHORAX – green and lightly wrinkled on disc; blue transverse impressions deep; sides arcuate, slightly more narrow at base than in front; recumbent white hairs sparsely distributed along the sides, and a few along the anter-

ior edge. ELYTRA – pigmented area bluish green; evenly punctate, very finely rugose between the punctures; punctures blue and shallower near apex; sides nearly parallel to apical fifth, then turning toward apex; suture toothed near apex; maculation white, completely connected along the outer edge, humeral lunule indicated by a thickening of the white border, central lunule descending obliquely, tip of apical lunule large and recurving toward the tip of the central lunule. LEGS – middle and anterior coxæ clothed with white recumbent hairs, hind coxæ glabrous; femurs blue, sparsely covered with white erect hairs; tibiæ green; tarsi long and slender. UNDERSIDE – head glabrous; thoracic sides green, color mostly hidden under dense long white recumbent hairs; last two abdominal sternites testaceous; the rest of the underside deep polished blue; sides of abdominal sternites, except last segment, clothed with white recumbent hairs. Male – length 11.8 mm, width 4.2 mm. Female – length 12.1 mm, width 4.6 mm.

TYPE LOCATION

Seven miles north of Furnace Creek, Death Valley, Inyo county, California. The elevation is 260 feet below sea level. At this location there are natural springs that drain in long shallow streamlets into the open alkali flats that constitute the drainage basin of Salt Creek. This area is wet from winter until mid-June, then the surface water dries up and only sub-surface moisture remains. Ssp. *pseudoerronea* occupies the area, in adult form, from the middle of April until June. A dead individual was found in November.

DISTRIBUTION

Death Valley, Inyo and San Bernardino counties, California. Aside from the type location there is another population at Saratoga Springs, 80 miles to the south. Here, they frequent the damp salt flats that make up the braided bed of the usually dry Amargosa River. This location, at 200 feet above sea level, is below the level of the high stage of Pluvial Lake Manly, therefore well within the valley from the entrance of the ancient Mojave River.

TYPE MATERIAL

Holotype male, allotype female, in the author's collection; collected at the type location on May 7, and May 5, 1954, respectively. 303 paratopotypes collected on the following dates: April 10, 1954 (25), April 11, 1954 (8), May 7, 1954 (125), May 29, 1954 (22), May 31, 1954 (7), June 5, 1954 (Cazier 5), April 16, 1955 (3), April 23, 1955 (4), May 8, 1955 (27), May 18, 1955 (17), May 5, 1956 (15), April 28, 1957 (45). 91 paratypes from Saratoga Springs collected May 7, 1955 (75), May 19, 1955 (16).

Distribution of paratypes: 2 to the Death Valley National Monument in care of Mr. E. Floyd Keller, naturalist; 4 to Dr. O. L. Cartwright of the U.S. National Museum; 10 to Mr. Lloyd M. Martin of the Los Angeles County Museum; 11 to Mr. Hugh B. Leech of the California Academy of Sciences; 8 to the Reverend Bernard Rotger of Pagosa Springs, Colorado; 6 to Mr. W. J. Brown of the Canadian Department of Agriculture; 5 to Mr. Darwin Tiemann of China Lake, California; 152 to Dr. Mont A. Cazier of the American Museum of Natural History. The remaining 196 are in the author's collection.

COMPARISON BETWEEN KNOWN POPULATIONS OF SSP. *PSEUDOERRONEA*

The populations from near Furnace Creek and Saratoga Springs are practically alike. In the latter the maculation is slightly broader, and the middle and apical lunules are nearly confluent in 6% of the individuals.

character compared	C. prætextata erronea	C. californica pseudoerronea
color	more individuals are green (74%)	more individuals are blue (58%)
maxillary palpi	1. pigmented at last segment, more so at tip.(joint overlap of 13%) 2. tip of last segment rounded	1.both last segments pigmented; 2nd joint pigmented dorsally 2. tip of last segment less rounded
elytra	evenly punctate all over	punctures more shallow near apex
maculation	1. generally narrower 2.central lunule usually descends toward apical; widest at middle	1.generally wider, especially so in the Saratoga Springs population 2.central lunule more oblique, ends further away from apical
prothorax	white hairs at both top and bottom edges, sometimes on disc	less hairs at top edge, usually none at bottom edge, none on disc
underside	all abdominal sternites pigmented	last and often penultimate sternite testaceous

Table A

Minor points of difference between ssp. *erronea* and ssp. *pseudoerronea* (exclusive of sexual differences)

Subspecies *erronea* is slightly longer than ssp. *pseudoerronea* as shown in Table B. This difference is not significant, and is too small to be readily noticed. That ssp. *erronea* is larger is in keeping with the greater size of ssp. *prætextata*.

COMPARISON WITH NEAREST RELATED SUBSPECIES

The main difference between ssp. *pseudoerronea* and its nearest relative *C. californica mojavi* is in the color and width of maculation. In ssp. *pseudoerronea* the color is always bright green or blue, and the maculation is relatively narrow, whereas in ssp. *mojavi* from Koehn Lake less individuals are green or blue, and in all cases the maculation is either broad or actually confluent. (Refer to Plate 32, figs. i, p, and q).

CHARACTERS RELATING SSP. *PSEUDOERRONEA* TO *C. CALIFORNICA*

That *pseudoerronea* is a subspecies of *C. californica* is recognizable by the general appearance, the maculation pattern, and especially by the primary sexual characters of the male. A typical penis of ssp. *pseudoerronea* is illustrated in Plate 32, fig. e; it is similar to the penis of other subspecies of *C. californica* in that the middle lobe is bulbous and the neck is comparatively thick. Figs. b, f, k, and o in Plate 32 illustrate the internal sacs of the *C. californica* subspecies; in ssp. *pseudoerronea* the membrane sustained by the flagellum is sometimes folded forward as shown in fig. o. A secondary sexual character represented by the penultimate abdominal sternite indicates that in *C. californica* the penial notch is deep, evenly curved, and the space separating it from the 5th sternite is relatively narrow.

CHARACTERS RELATING SSP. *ERRONEA* TO *C. PRÆTEXTATA*

That *erronea* is a subspecies of *C. prætextata* is more difficult to recognize by any feature of the facies, however the sex characters of the male readily reveal the relationship. The penis has a slender neck that expands evenly to the median lobe, and the internal sac is of the *C. praetextata* type as illustrated in Plate 31, figs. b and e. The penultimate abdominal sternite has a shallow penial notch, with a relatively wider space between the base of the notch and the 5th sternite.

subspecies	population	sample size			longest (mm)	shortest (mm)	average length			s
		n	♂	♀			$\bar{X}$	$\bar{X}$♂	$\bar{X}$♀	
prætextata erronea	Willcox, Ariz.	20	10	10	13.4 ♀	11.0 ♂	12.1	11.9	12.3	.67
californica pseudoerronea	Furnace Creek	20	10	10	12.7 ♀	10.9 ♂	11.9	11.7	12.0	.43

Table B

Comparison of length between ssp. *erronea* and ssp. *pseudoerronea*.

COMPARISON BETWEEN SSP. *ERRONEA* AND SSP. *PSEUDOERRONEA*.

Subspecies *erronea* and *pseudoerronea* are obvious siblings. They are so similar in appearance that it would be difficult to correctly identify all of the individuals if they were mixed indiscriminately.

Plate 31, fig. h of ssp. *erronea* and Plate 32, fig. i of ssp. *pseudoerronea* attempt to illustrate generalizations of the maculation that may be noticed in large series. Ssp. *erronea* has a middle lunule that usually extends downward toward the apical lunule. In ssp. *pseudoerronea* the middle lunule usually extends obliquely, and sometimes bears a slight bulb at the tip. Table A lists some minor points of difference.

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AUSTRALIAN LEAF-EATING LADYBIRD BEETLE *Epilachna vigintioctopunctata* Fabr., AS A POSSIBLE AGRICULTURAL PEST IN THE U. S. A.

(Notes on North American Coleoptera, No. 3)

By CHARLES S. PAPP

While collecting beetles in an area approximately 8 to 10 miles northeast of Del Mar, San Diego County, California (July 1954), I found two specimens of a strange ladybird beetle, a kind which I had never collected before. After careful investigation, I found to my surprise, that these represent a common species in the Pacific Islands and Australia. They are a well known and extremely dangerous, leaf-eating ladybird beetle, an agricultural pest, *Epilachna vigintioctopunctata* F. The question now arises: Do we now have to face the same situation as had to be faced with the khapra beetle problem?

After it was clear to me that there was no time to lose, I contacted U. S. officials and reported my find. Recently, (in September 1956) I decided to contact Australian experiment stations. I have established contact with officials from the South Pacific Islands and Australia, with very good results.

I wish to express my sincere thanks to the following individuals and institutions: Dr. A. J. Nicholson, Chief, Division of Entomology, Commonwealth Scientific and Industrial Research Organization, Camberra City, A.C.T., Australia, for prompt answers, for bibliographical references and specimens, and for checking identification; to S. L. Allan, Chief Entomologist, Department of Agriculture of New South Wales, in Sidney, Australia, for his kind advice on literature; to the Department of Agriculture of Fiji, Suva, Fiji; and to the Technical Secretary of the Department of Agriculture and Stock in Brisbane, Queensland, Australia, for reference literature.

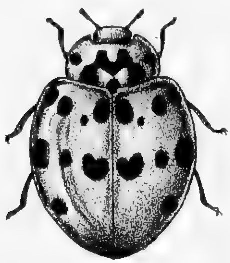
DISTRIBUTION

The species in question, has a very wide distribution. It is known from Ceylon (Weise 1900) to the South Pacific Islands, being reported from an elevation up to 1300-1500 feet by C. T. McNamara; the Solomon Islands, Guadalcanal Island by J. A. Kusche; Fulakora Island by C. Bignell and L. J. Dumbleton; Bougainville Island by L. F. Gunther and R. Ross. In Australia

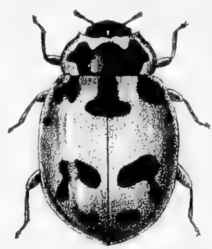
Convergens Ladybird Beetle
(*Hippodamia convergens*)

Twice-stabbed Ladybird
(*Chlorocorus bivulnerus*)

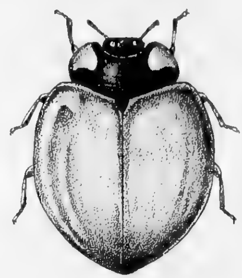
American Ladybird Beetle
(*Hippodamia americana*)



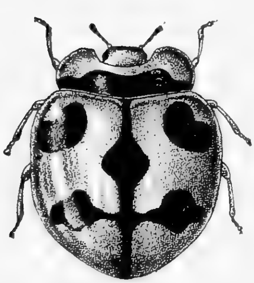
Ash-gray Ladybird Beetle
(*Olla abdominalis*)



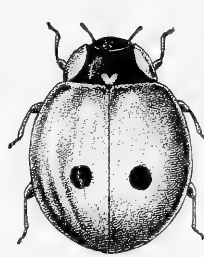
Washington's Ladybird Beetle
(*Hippodamia washingtoni*)



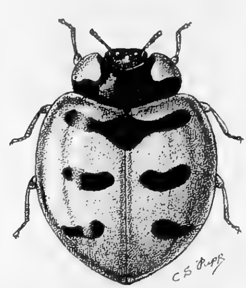
California Ladybird Beetle
(*Coccinella californica*)



Vedalia
or Australian Ladybird Beetle
(*Rodiola cardinalis*)



Two-spotted Ladybird Beetle
(*Adalia bipunctata*)



Eastern Ladybird Beetle
(*Coccinella transversoguttata*)

PLATE 33

Common North-American Ladybird Beetles. The Vedalia. (*Rodolia cardinalis*) also a native of Australia. All of them are beneficial insects.

it is well known from the Northern Territory, Darwin, Stapleton, Roper River, and Behn River, by G. F. Hill, N. B. Tisdale and E. Kimberley, and from New South Wales by R. W. Burrel, A. Koebele and H. Peterson. From Samoa Islands it has been reported by many collectors including O. H. Swezey, E. C. Zimmermann, D. F. Fallaway and E. H. Bryan, Jr. It is known from the Fiji Islands as reported by L. J. Dumbleton and R. J. Lever.

Many collectors have reported *E.28-punctata* from India, Indonesia, South China and north to the southern Japanese Islands. Recently, however, it has been made clear (Dieke 1947) that specimens from these regions belong to a different species. It may be the same with specimens from Ceylon, as reported earlier by Weise (1900).

AGRICULTURAL IMPORTANCE

The first report of injury by *E. 28-punctata* was presented by A. S. Oliff in 1890 as "one of the worst enemies of potatoes, pumpkins and tomatoes" — from New South Wales, Australia. The report was so important and dramatic, that the Government of New South Wales reprinted it, and immediately called the beetle to the attention of the farmers. After this report appeared, the beetle attracted a great amount of attention from economic entomologists, especially in New South Wales. Reports reaching officials included many that were very serious, such as plague-like infestations that occurred commonly in certain districts. The Epilachna problem has been of major interest to economists, and the local government has had to call on the public for cooperation many times during the past 65 years. The problem still is very serious. Short reports still appear in newspapers, on bulletin boards and in the New South Wales Agricultural Gazette.

Damages due to this beetle were later recognized in Queensland, where the Department of Agriculture and Stock, in Brisbane, started a campaign and undertook an expansive research program to combat this insect enemy.

Subsquently reports appeared from the southeastern corner of the Continent, Victoria, where the first by R. Prescott, intensively summarized the damage of the beetle. Lastly, from the islands mentioned above (including New Zealand) and all through the South Pacific, similar reports were received.

Epilachna 28-punctata is a tropical species and feeds on solanaceous and cucurbitaceous plants, with serious damage being reported on tomatoes, potatoes, melons, pumpkins, squash, cucumbers, tobacco, nightshade and cotton. Generally speaking, it is chiefly distributed and is economically important in the

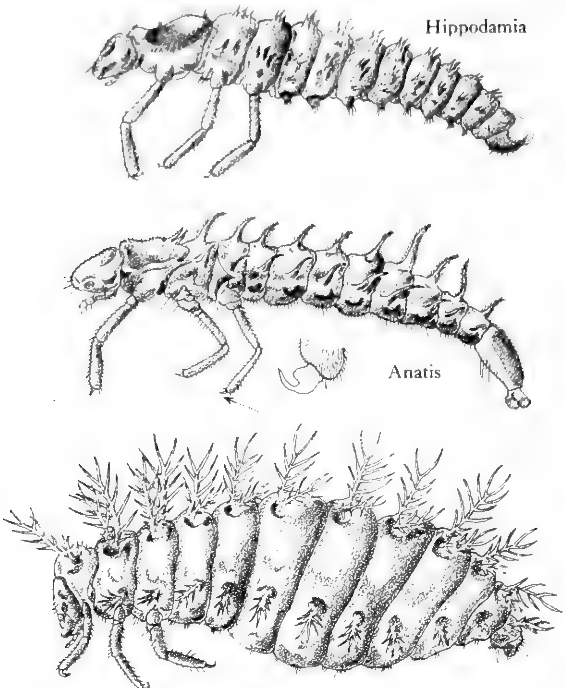


PLATE 34

Types of Coccinellid larvae from North America. Note the typical spiny form of the *Epilachna* larva.

Western half of Australia (the Northern Territory, Queensland. New South Wales and Victoria). I do not have reports from Tasmania, which is closer to Victoria than New Zealand, an area where the species has been collected.

Veitch and Simmonds (1928) states, that the damage inflicted by this beetle is due to the feeding of both the adult beetle and the larva of the species; the former feeding freely on the upper and lower surfaces of the leaves, while the latter concentrates on the lower surface. The damaged area appears as a fairly long narrow strip of tissue on the under side of the leaf. In feeding, this beetle does not eat completely through the leaf. After the

first long narrow strip has been cut, a second strip is cut alongside of the first one, the two strips being separated from each other by only a very thin ridge of undamaged tissue. This process is repeated again and again until a comparatively large ragged patch is eaten out of the under side of the leaf, only the thinnest layer of tissue being left intact on the upper surface. In some cases, however, the beetle may eat completely through the tissue of the leaf. In recent epidemics this pest has been present in such numbers that the foliage, in many cases, has been practically destroyed, with even the stems of the attacked plants being seriously injured. Where extensive injury is inflicted on the foliage, there must obviously be a very much reduced yield of edible product of the plant attacked.

LIFE HISTORY.

Experimental laboratories of the Australian government and a great number of entomologists in fields and gardens of the infected areas have accomplished extensive research on the life cycle of this beetle. I have not had the opportunity to do my own research as yet, consequently my contribution to the knowledge of *E. 28-punctata* is the result of bibliographical study and the compilation of research results of others offered by mail.

THE EGGS, yellow in color, are laid in clusters on the foliage. The number laid in each cluster in the field has varied from 13 to 45. The eggs are typical of ladybird eggs, being elongate-oval in shape and measuring about one-sixth of an inch in length. The surface of the egg is beautifully reticulated, but such detail can be observed only with the aid of a lens. The eggs are glued to the foliage at their broader ends. The incubation period during one of the larger outbreaks was 4 days.

THE LARVA (Plate 35, fig. 1) is a most extraordinary spiny-looking creature and when full-grown, measures about one-third of an inch in length. The under surface of the body is yellow, while the upper surface is similarly colored, except for the fact that the color is broken by rectangular brown areas at the bases of the many-branched spines. This gives the larva an awe-inspiring aspect. The larva possesses three pairs of legs. The larval period lasts about three weeks, and during that growth period it moults four times.

THE PUPA (Plate 35, fig. 2) is approximately one-fourth of an inch in length, and is found securely fixed to the leaf, stalk, or main stem. A conspicuous feature of this pupa is the fact that the last larval skin (shed when pupation takes place) is attached to the abdominal extermity of the pupa. The pupa itself possesses

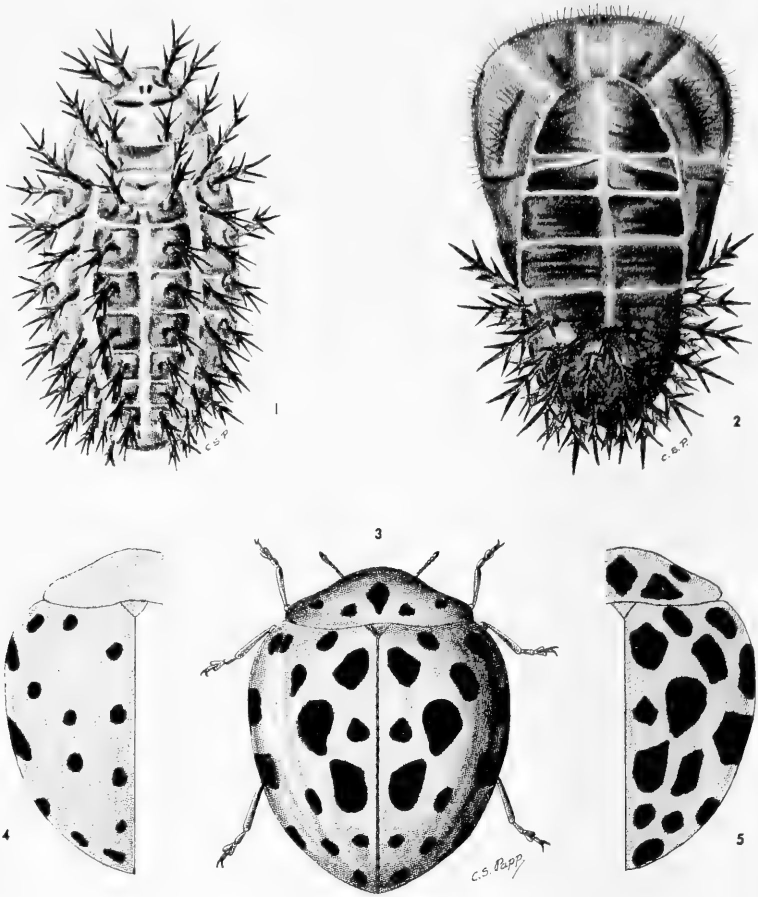


PLATE 35

The Austrailian Leaf-Eating Ladybird Beetle (*Epilachna 28-punctata F.*). 1. Larva, 2. Pupa, 3. Adult. Figs. 4 and 5 are samples of possible maculations.

dark brown markings, broken by cream-colored patches. The pupal stage during the warmer months in Queensland, has been found to extend over a period of only four days.

Adult. The oval-shaped beetle (Plate 35, figs. 3-5) is about one-fourth of an inch in length and is yellowish-brown in color. The wing covers bear a number of very conspicuous black spots, from which the name *28-punctata* is derived. The number and size of these spots is not, however, constant and they may vary from 12 to 14 on each elytron. In occasional specimens, the yellowish-brown body color is replaced by a much darker shade. This gives the beetle a very dark appearance, and in these specimens, the black spots do not stand out as conspicuously as in those that are normally marked. Like other ladybird beetles, this species secretes an unpleasant, evil-smelling, yellowish fluid when it is handled. Life-history investigations by Miss Temperley (1928) showed that in the laboratory the female beetle may lay as many as 252 eggs, which is much more than in its natural habitat.

SIMILARITY WITHIN SPECIES

It is certainly important to be able to correctly determine the various species of *Epilachna*. G. H. Dieke (1947) wrote an excellent paper which is of very great help.

In the following account I have given short descriptions with illustrations of some of the most important species of *Epilachna*. Several of these already occur in the United States, while others are not members of our fauna as yet, but may be confusing because of their similarity in maculation, shape and size to *E. 28-punctata*. It is important, especially to our southwestern entomologists, to be able to recognize and separate the different species in this genus, and have correct identification labels in their reports. I omit the key-system which in some cases (in certain points) makes the identification difficult and the result questionable.

The Epilachna sparsa group

Varies between wide limits, both among the specimens found at one locality and between the various geographical races. The under side may vary from completely light yellowish red, including legs and appendages of head, to dark brown to black on metasternum and a large part of abdomen. The ground color of the upper side is red. The pronotum varies in maculation from the spotless form to the form with all spots well developed and beginning to coalesce. The elytra vary between the form with 6 spots on each elytron and the other extreme with 14 spots present. Rarely is one of the persistent spots missing, but practically any number of spots between 6 and 14 may be expected with greatly varying sizes of individual spots.

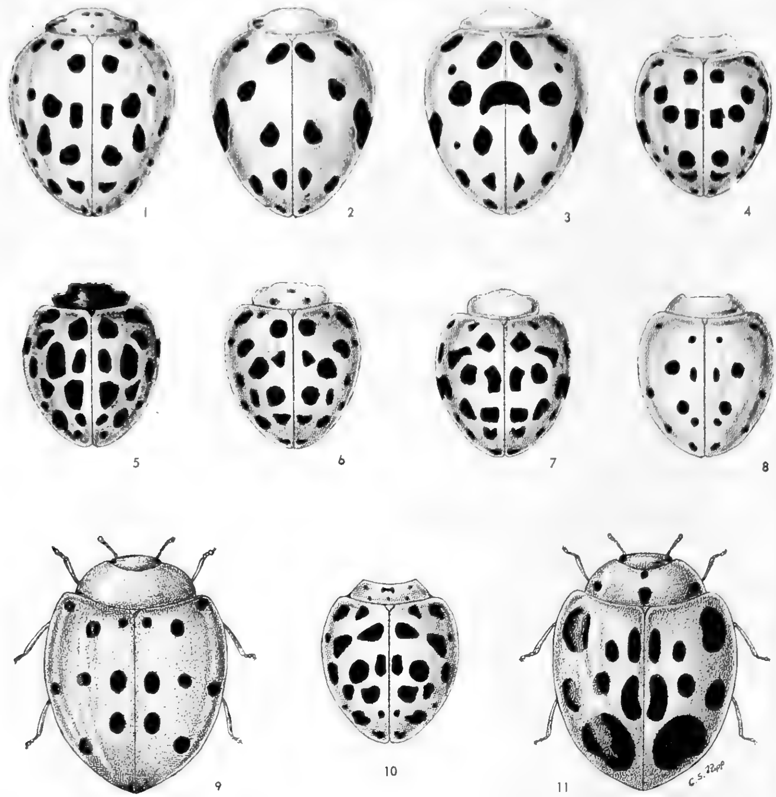


PLATE 36

Most common types of *Epilachna* species from the Australian region showing two examples (9. and 11) from the U.S.A.—1. *E. sparsa ssp. orientalis* Dieke, 2-3. *E. sparsa* ssp. *territa* Muls., 4. *E. sparsa* ssp. *26-punctata* (Boisd.), 5. *E. reducta* Dieke, 6. *E. philippinensis* Dieke, 7. *E. dentulata* Dieke, 8. *E. sparsa* ssp. *sparsa* (Hbst.), 9. *E. corrupta* Muls. (from *U.S.A.*), 10. *E niponica* Lewis, 11. *E. borealis* (F.) (from U. S. A.).

On the Asiatic Continent it ranges from India to North China, also in southern and central Japan, Sumatra, Java, Lombok, New Guinea, and Australia to Fiji and Samoa; not known from the Philippines.

E. sparsa ssp. sparsa (Hbst.) known from India with many variations (such as *addita* Muls., *vieta* Muls., *socors* Muls. and *congressa* Muls.). The most frequent form is figured on Plate 36 fig. 8.

E. sparsa ssp. orientalis Dieke. From China and Japan. This subspecies is usually called in the literature *E. 28-punctata* Mots. and often *28-punctata* F. Pronotum usually with seven distinct spots. Under side light, with sides of metasternum usually black. The dark color may be spread to most of the abdomen, the sides of which, however, always seem to remain lighter. Plate 36 fig. 1.

E. sparsa ssp. territa Muls. Recorded only from Java. Appears to be the 12-spotted form of *ssp. sparsa.* The nonpersistent spots are much smaller than the persistent ones. The fully developed form with all 28 spots has not been recorded. Plate 36 fig. 2-3.

E. sparsa ssp. 26-punctata (Boisd). Has a very peculiar color variation from Fiji (*var. nigrescens* Dieke) in which the larger part of the elytra is solidly black. From Australia and the Pacific Islands, eastward to the Manua group. *Ofu,* the subspecies is very constant in appearance and is well characterized on Plate 36 fig. 4.

THE FOOD PLANTS in the *E. sparsa* group are usually the following: Ground Cherries *(Physalis alkekengi),* Black Nightshade *(Solanum nigrum),* Potato *(Solanum tuberosum),* Eggplant *(Solanum melongena esculentum),* Tomato *(Lycopersicum),* Thorn Apple *(Datura alba),* Cucumber *(Cucumis sativus).* In Japan the chief damage is to potatoes and eggplants. In China more damage is done to eggplants, and cucurbitaceous plants are not attacked in the field when other food is available. The total period from egg to emergence of adult is 20 to 46 days. In warmer regions (with a mean temperature of 28.6°C) the period is about 16-17 days and there are 5 to 6 generations a year.

EPILACHNA PHILIPPINENSIS Dieke

Pronotum usually immaculate, occasionally with two spots and traces of others. Elytra usually with the full number of spots (28): Plate 36 fig. 6. Known from the Philippines. The fully spotted form from Luzon. The *ssp. remota* Dieke, also from the Philippine Islands, differs from the *forma typica* by the absence of all the nonpersistent spots on the elytra. Consequently there are only six spots on each elytron. This form seems to occur on the outlying islands rather than on Luzon. The *ssp. australica* Dieke from Australia (New South Wales, Richmond River, Botany Bay) resembles in maculation, the dark specimens of *E.28-punctata.*

EPILACHNA DENTULATA Dieke

Upper side brownish red. Pronotum varying from spotless to one with all seven spots present. Pubescence light gray, dark on

the spots. Elytra with all 28 spots arranged as in *28-punctata*. Specimens from the Philippines have larger spots, those from Indo China have smaller. Plate 36 fig. 7. Very similar to *Afidenta mimetica* Dieke, which has brownish red upper side, pronotum with a transverse row of four black rounded spots near the middle (or just in front of it), spaces equidistant, these spots occasionally obsolete. Elytra each with 14 black spots arranged similarly to *Epilachna 28-punctata* or closely allied species. Pubescence dense, light blond, dark on the spots. Under side and appendages light, sides of metasternum darker. Specimens from Tibet also have dark abdomen, mesosternum and metasternum. Known from China and Indo China.

Epilachna reducta Dieke

Upper side light brownish red. Pronotum black with light edges. Elytra with 13 spots each. Spots are large and show a tendency to be elongated. Under side, except the head, black, epipleura, tarsi, antennae and mouth parts light, femora and tibiae black with light apices. Abdominal segments with shallow impressions on sides. Known from the Philippines. Plate 36, fig. 5.

Epilachna niponica Lewis

Upper side, light reddish brown. Head often with two confluent dark spots at middle of base. Elytra with full complement of 28 spots, the non-persistent ones nearly as fully developed as the persistent ones. Under side and appendages light in the lighter specimens with the sides of the metasternum and the middle of the basal abdominal segments dark. In the darker specimens the dark color spreads over the whole under side, including spots on the femora and the elytral epipleura. However, even in very dark specimens, the depression in the middle of the fifth abdominal segment of the female is light. —Reported from Japan, China, Manchuria, Southern Korea and Siberia. Plate 36, fig. 10.

The eggs, as usual, laid in open clusters on the under side of leaves with an average number of 440-450 per female (in laboratory 222-896 per female). The durations of the several stages are: egg 3-11 days, larvae 14-27 days with 4 instars, pupa 4-8 days. Egg to emergence of adult 25-45 days. Oviposition period 17-40 days. End of egg laying to death 2-29 days, average 15 days. Hibernates as adult.

Injurious to more than 30 species of plants (in Japan):

Solanaceae: Potato, Egg Plant, Tomato, Red Pepper, also *Solanum nigrum*, *Solanum ovigerum*, *Physalis alkekengi*, *Physalis angulata* and *Datura alba*. *Cucurbitaceae:* Cucumber and Squash. *Leguminosae:* Bean and Soybean. *Compositae: Arctium lappa*. *Cruciferae: Brassica campestris.*

Any of the above mentioned species could be a very dangerous agricultural pest in our country. In case any of these are collected, it is highly recommended that you report the occurrence and send the specimens to the closest possible Agricultural Experiment Station of the United States Department of Agriculture, to county Stations or to the writer (1555 New York Dr., Altadena, California).

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THE STATUS OF TWO GEOMETRID NAMES

Carl W. Kirkwood

Summerland, Calif.

Stenoporpia grisearia was described in the genus *Cymatophora* by Grote from a single female in 1883. Twenty-four years later in the year 1907, Swett described *Cleora pexata* from two males.

J. H. McDunnough in his revision of the North American Cleorini, placed *grisearia* under species not examined, but stated that from his remembrance it was close to *dionaria* B. & McD. He then placed *dionaria* in his newly erected genus *Stenoporpia*, and at the same time placed *pexata* in the genus *Glena* Hulst. In 1938 when he published his check list he put *grisearia* in the genus *Stenoporpia*.

In working over species of the Cleorini in my own collection, the author began to suspect, that perhaps *grisearia* and *pexata* were one and the same thing. In a query to Dr. Frederick H. Rindge of the American Museum of Natural History, he had replied that several years ago when making genitalic slides of specimens in these groups he had put a note in the Museum collection as to whether or not Swett's name would be the same as *grisearia*.

Through the generosity of Dr. E. L. Todd of the U. S. National Museum, the author was able to secure a photograph of the type of *Cymatophora grisearia*, along with a drawing of the genitalia. In a letter from Dr. Todd he goes on to say that the males they have under this name appear to be the same as those they have under the name *pexata*, agreeing in both genitalia and maculation. However, none of the specimens have the postmedial line so black, or so well marked, as the type of *grisearia*.

The only thing that can be definitely stated about the type of *pexata*, is that it is in the Museum of Comparative Zoology.

Grisearia should be removed from the genus *Stenoporpia* and transferred to the genus *Glena* with *pexata* as a synonym.

My sincere thanks to Dr. E. L. Todd of the U. S. National Museum, and Dr. F. H. Rindge of the American Museum of Natural History. Without their valued help this paper would not have been possible.

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A.

B.

PLATE 37

Fig. A. Genitalia of type.

Fig. B. Type of Cymatophora grisearia Grt.

Genitalic drawing and photo. courtesy of Dr. E. L. Todd, U. S. National Museum.

THE HABITS AND LIFE HISTORIES OF *Cochisea sinuaria* B. & McD. and *Cochisea sonomensis* B. & McD. (Lepidoptera: Geomtridae)

By John Adams Comstock, Christopher Henne and Frank Sala

INTRODUCTION

For the past twelve years a group of lepidopterists have been interested in obtaining information on the habits and metamorphoses of two rare moths of the genus *Cochisea,* which occur in the mountainous areas adjacent to Los Angeles. These moths are *Cochisea sinuaria* and *C. sonomensis.*

This interest began in May of 1939, when the senior author of this paper located and photographed a larva feeding on *Cercocarpus* in Bouquet Canyon, which subsequently proved to be *Cochisea sinuaria.*

This was followed in 1946 by a report from Chris Henne, who had obtained eggs from a gravid female *Cochisea,* captured on the Ridge Route, south of Gorman, October 24, 1946. Young larvae obtained from these eggs were reared on Piñon (*Pinus cembroides monophylla* Voss.) and notes were made of the mature larva and pupa by Chris Henne, and also by J. A. Comstock. These proved, on emergence, to be *Cochisea sonomensis abrunnea* B. & McD.

On May 31 of the following year Phil Adams brought in mature larvae of the same species, which he had collected on Piñon, at Chuchupate Camp, Los Padres National Forest (Frazier Mountain Park area), Kern County, California. The larva was photographed, and subsequently J. A. Comstock prepared a drawing of the pupa.

In November of 1955 Noel McFarland obtained eggs from a female of *Cochisea sinuaria*, taken in the Hollywood Hills, Los Angeles County. Examples were reared on *Rhus laurina* Nutt., by Frank Sala and J. A. Comstock. Mr. Sala also noted that the larvae fed on several species of *Manzanita*, on *Quercus chrysolepis* Liebm., and *Q. agrifolia* Neé, and on *Adenostoma* sp. From the same material Comstock prepared drawings of the egg, larva and pupa.

By correlating and editing the notes of the three workers most vitally interested in the problem, we are enabled to present this joint paper on the life histories of *Cochisea sinuaria* and C. sonomensis.

Cochisca sinuaria B. & McD.

HABITS AND HABITAT

This beautiful geometrid moth is rare in collections, due probably to its late emergence, restricted habitat, and short span of life as an imago. The balmy evenings of late October and early November are the times of choice for its emergence.

Favorite habitats are chapparal and oak locales, and canyon heads that have not been completely cleared by man.

The females are especially difficult to secure, as the collector must set up a light sheet in the breeding area and wait out a cool evening of lantern collecting in the hope of securing an example. Diligent beating of the food plant in the late spring may result in an occasional larva.

Mating occurs the first night after emergence, and the eggs are deposited singly or in small clusters within the crevices of the bark of its plant of choice.

The larva remains from 40 to 60 days in the ovum. It is interesting to note that the imaginal stage preceeds the normal rainy period of the southern California winter, and that the larvae do not emerge until after the commencement of winter rains, when the host plants have been conditioned for their feeding.

The timing of larval stages is typical of winter species in this area, as their rate of growth has a definite corellation with the weather. The first three instars are completed in from 5 to 25 days, the fourth instar takes from 8 to 30 days, and the fifth or final instar is consummated in from 12 to 37 days.

Pupation occurs underground after a six day prepupal period.

Typical of most fall-flying nocturnal lepidoptera, the pupal diapause is extended through the summer, and apparently is broken by the advent of the autumnal cool weather. Indian summer breaks in this coolness serve to trigger the emergence of the imagines, and thus the cycle of their development is completed.

THE EGG

Elongate-ovoid, the top rounded and the base slightly flattened.

Length, 1 mm. Width, .75 mm. These measurements were for an average egg. Considerable disparity in size was noted in the seven examples studied.

Color:—glistening olive-green, with almost a metallic glint.

Texture and sculpturing:—The surface is covered with from 35 to 40 longitudinal ridges, several of which thin out and disappear near the top and base. Between these ridges there are fine transverse striations, the walls of which do not rise to the same levels as the longitudinal ridges. The minute pits or cells that are thus defined are quadrate, and relatively deep.

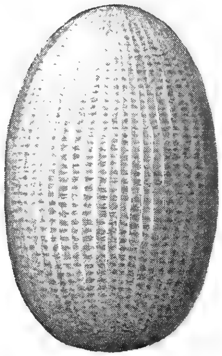

Plate 38

Egg of *Cochisea sinuaria* B. & McD. enlarged x 46

Reproduced from drawing by John Adams Comstock

There is no depression in the micropylar area. The egg is illustrated on Plate 38.

LARVAE OF VARIOUS INSTARS

Larva of 10 mm. length.

Head, ovate; width 1.4 mm.; topped with a pair of papilliform tubercles, each rising superiorly above each cheek, and topped by a single minute hair. The color is predominantly a mottled dull maroon, which gradually changes to a mottled light brown as the adfrontal suture is approached. This suture is narrowly edged with brown. The front is yellow-brown.

Mouth parts and antennae, dark brown. Ocelli, black.

Body, cylindrical. Color, mottled maroon, with a powdering of white in certain areas.

The first segment is considerably taller and wider than the head. It bears a prominent ridge superiorly, edged along the front with black, and transversely along the top with white.

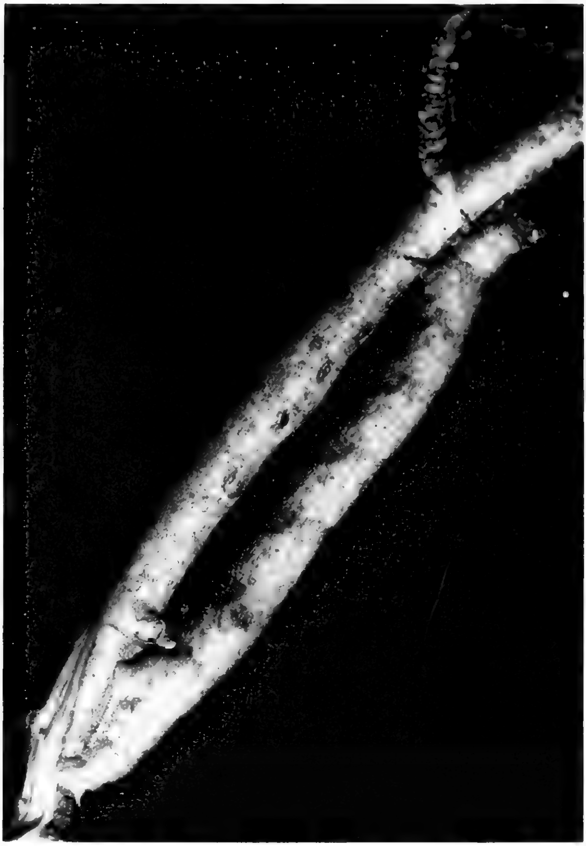

PLATE 39

Mature larva of *Cochisea sinuaria* B & McD., on twig of *Cercocarpus*, enlarged approximately x 1 8/10.

Photo courtesy Los Angeles County Museum.

There is a faint suggestion of a double middorsal dark discontinuous line, and lateral to this a faint discontinuous gray-white band.

Around each spiracle there occurs a mottled area of olive green or dull yellow.

All of the body colors are so blended and mottled as to give the appearance of a uniform dull maroon, which simulates the color of the *Rhus* stems.

The outstanding feature is a large black warty tubercle on each side of the eighth segment, placed immediately above the spiracle. The legs are maroon, of a lighter shade than the body. The single pair of prolegs, and anal prolegs are concolorous with the body.

Larva of 20 mm. length.

Head width, 2 mm. The adfrontal sutures show a dark brown inverted V on the superior half. The two papilliform processes on the crest of the head have become proportionately larger, and are covered with warty nodules.

The body color has become slightly more grayish although the maroon shade still dominates. The spiracles are orange, with burnt orange rims.

The chief difference is in the tubercles on the eighth segment. These have become elongated to twice the height of their diameter. They incline upward and outward, with a slight inclination caudad, and are now black. Each is covered with short spiculiferous nodules.

The enlargement over the crest of the first segment has lost the white shading and is nearly black. It is topped with a row of spiculiferous white nodules which, however, are discontinuous on the middorsal portion of the crest.

Larva of 55 mm. length, in final instar. Greatest width, 5 mm.

Head, 5 mm. wide X 4.1 mm. long from top of tubercle to lower edge of cheek.

The body is a russet-brown with a tinge of red-brown, overlaid with a scattering of gray-white dots. The conical tubercles on the eighth segment are much reduced in length.

One example has considerable olive-green along the lateral surfaces.

Of the six examples that reached maturity, one went underground on March 14, two on March 16, one on March 18, and the last two on March 23, 1956.

The mature larva is illustrated on Plate 39, and Plate 40, figure B.

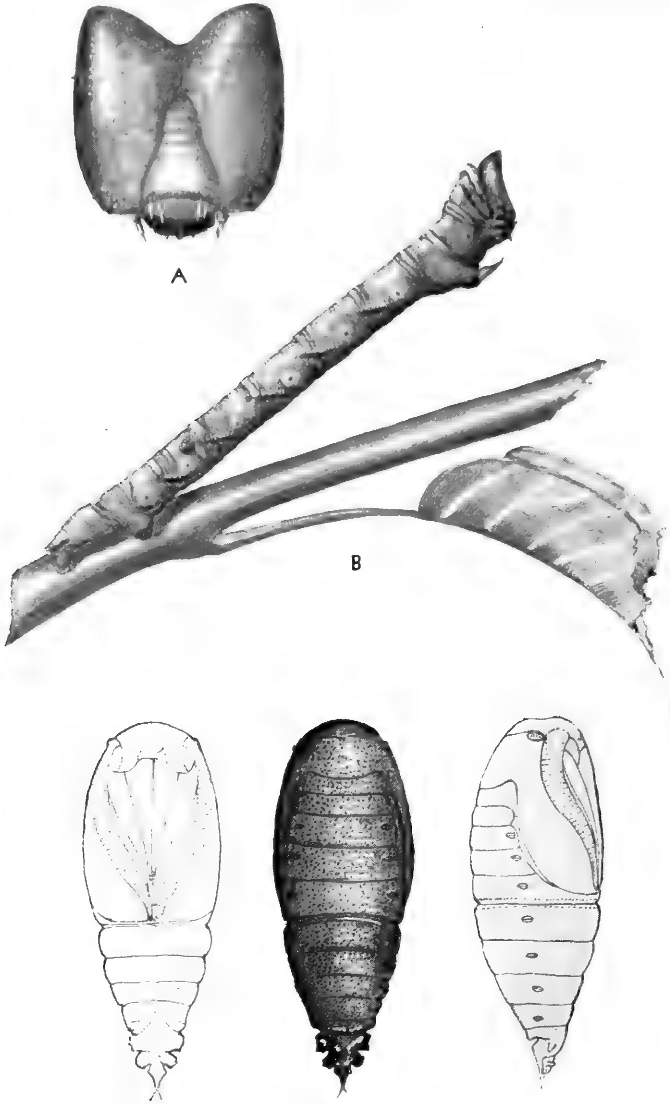

PLATE 40

Mature larva, and pupa of *Cochisea sinuaria* B. & McD.
A. Front view of larval head, enlarged x 5½.
B. Larva, lateral aspect, resting on a twig of *Rhus laurina*, enlarged x 1¼.
C. Pupa, dorsal aspect, enlarged x 2-1/5.
D. Pupa, (diagrammatic), ventral aspect.
E. Pupa, (diagrammatic), lateral aspect.
Reproduced from painting by John Adams Comstock

PUPA

Length, 20 to 22.5 mm. Width, 7 to 8.5 mm.

Color, brownish black, with a tinge of madrone-red on the ventral surface.

Form, subfusiform, the cephalic end broadly and evenly rounded; the thoracic portion stout, tapering to the heavily noduled cauda. The maxillae are broad at their bases and taper to pointed tips at about three-fourths the distance toward the wing margins. The antennae are wide at the cephalic end, and taper gradually to a rounded tip at the margin of the wings.

Spiracles, concolorous with body. Cremaster, heavily lobulated and rugose, terminating in a single spine on two individuals, and a forked pair on the remaining four.

Texture; heavily punctate throughout. There are apparently no setae or vibrissae, but magnification discloses an occasional short black hair over the cephalic area and on the lateral abdominal surfaces. See Plate 40, figures C, D and E.

The pupae gave forth imagines on the following dates:

1 ♀	July 25, 1956	1 ♂	September 8, 1956
1 ♀	July 27, "	1 ♂	October 14, "
1 ♀	August 6, "	1 ♂	October 23, ".

The earlier dates of emerging may have been due to somewhat artificial laboratory conditions, and cool periods during part of the summer.

Cochisea sonomensis B. & McD.

No record or illustration of the egg of this species was made at the time when the first lot was secured in 1946. It would be interesting to know if there is any difference between it and the egg of *C. sinuaria.* The only information we have is that the eggs were laid between October 24 and 27, 1946, and hatched in from two to four weeks.

The larvae were reared to maturity on Piñon (*Pinus cembroides monophylla* Voss). They were of two types, one being predominantly gray, with light brown pencilings, and the other, green with dull white spottings. The green form was much more common than the gray, and is hereinafter described. Its color is highly protective when resting among the pine needles.

PLATE 41

Mature larva of *Cochisea sonomensis* B. & McD. A. Lateral aspect. B. Dorsal aspect. Figures enlarged x 2½.

MATURE LARVA

Length, 35 mm. Cylindrical, slightly tapering toward cauda.

Head, slightly narrower than the first segment, with the front of the face flattened, and the upper extremity of each cheek extended upward as a rounded tubercle or knob. The color of the head is reddish brown. The ocelli are black.

Body, ground color dull green. A narrow reddish brown mid-dorsal stripe runs the entire length of the body. It is bordered laterally by a wider yellowish white band, on which occur a few diagonal pencilings in the center of each segment. Lateral thereto is a wide green band of the exact shade of the Piñon needles. The spiracles are placed on the inferior margin of this band. They are dark red-brown.

A narrow, somewhat crenulate substigmatal dark stripe runs the entire length of the body.

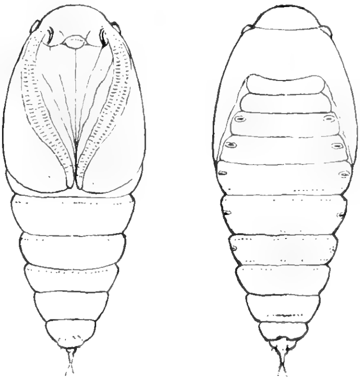

PLATE 42

Pupa of *Cochisea sonomensis* B. & McD. A. Ventral aspect. B. Dorsal aspect. Figures enlarged approximately x 3. Drawing by J. A. Comstock.

The abdominal surface is mottled green and yellow, with a few irregular greenish brown pencilings on the caudal edge of each segment.

Legs, dull green, shading into dark brown at the tips.

Proleg, mottled dull ivory with reddish brown pencilings.

Anal proleg, dull green, with reddish brown mottling.

The larva is illustrated on Plate 41.

PUPA

Length, 18 mm. Greatest width through fourth abdominal segment, 7 mm.

Form; subfusiform, the cephalic end well rounded, the thoracic and central areas wide, and the post abdominal and caudal end tapering sharply. The cremaster is more rounded and regular in outline, and less rugose than that of *C. sinuaria.* It terminates in a straight single spur, bifurcated only at the tip. There is a minute seta lateral to the spur.

The maxillae extend to about three-fourths the distance toward wing margins, and the antennae terminate at the wing margins.

Surface texture; Head, thorax and wing cases, rugose. The abdominal segments are finely punctate.

Color; dark reddish brown, the head elements slightly darker and the cremaster brownish black. See plate 42.

SCIENTIFIC NOTES

During the process of obtaining information on the life histories of lepidoptera it frequently occurs that eggs are obtained from females which produce first instar larvae for which it is impossible to find suitable food plants.

The temptation in such cases is to lay aside the records until more complete information might come to hand. All too frequently the notes are forgotten, and valuable data thus lost to science.

The egg and first instar larva is probably of greater importance than all other phases of the life cycle, since they are more likely to give information on phylogenetic relationships than are the late instars and pupa. We consider this fact sufficient justification for the publishing of fragmentary records such as the following, when they shed light on the metamorphoses of species not heretofore recorded in the literature.

Aemilia ambigua Stkr.

Eggs of this handsome arctiid were collected by Noel McFarland at the 7 C Bar Guest Ranch, seven miles west of Williams, Coconino County, Arizona, between August 9 and 15, 1956.

The egg is oval, with one side flattened. It is laid with the flat side downward. Its color is ivory.

It measures 1.75 mm. long by 1.55 mm. wide, and is about 1.2 mm. in height.

The surface appears smooth and granular, but magnification shows a fine network of minute hexagonal cells, with raised walls and depressed centers.

The eggs hatched between August 24 and August 27, 1956.

First instar larva: Length, 3.5 mm. Cylindrical and stout.

Head; width, 1 mm. which is much wider than the first body segment; strongly bilobed. The color is deep orange, with the mouth parts tipped with brown, and the ocelli, black.

Body; ground color, ivory. The scutellum is yellow.

There are several rows of longitudinally placed papillae. The first row, close to the middorsal line, is composed of small elements, each bearing a short black hair. The second (lateral) row is placed on a longitudinal yellow line. The papillae are larger, and bear two or three long black hairs. The remaining rows are similar to the last described. but do not have the yellow line running at their bases.

The legs and prolegs are concolorous with the body.

The young larvae were offered oak, willow, sumac and *Melilotus*, all of which they refused.

Dasylophia seriata (Druce)

Eggs were collected by Noel McFarland at the same locality and on the same dates as those previously mentioned. The eggs hatched before we were able to make notes, and the description is based on the appearance of the egg shell.

Egg: Hemispherical, the base flat and the top gently arched. It measures .75 mm. high by 1.3 mm. wide.

The surface is covered with a network of minute hexagonal cells. There are no ridges, and apparently no micropyle.

Egress of the larva was made from the side of the egg, the shell being left nearly intact.

First instar larva: Length, 2.5 mm.

Head; width, approximately .5 mm.; somewhat flattened, and fully twice the width of body. Color, light orange, including the mouth parts. Ocelli, black. The head is clothed with numerous long black hairs.

Body; cylindrical. Ground color, yellow. There is a very narrow mid-dorsal longitudinal red-brown stripe, and two others paralleling it laterally. A pair of warty black papillae occur on the fourth segment, each placed dorso-laterally, and two similar pairs (slightly smaller and brown) are placed on the tenth and eleventh segments.

Legs, yellow. There are four pair of prolegs, on which the lateral surfaces are black. The caudal pair of prolegs are spotted black. The supra-anal triangle is also black.

Numerous simple hairs occur on the body, those at the cephalic end being longest.

The larva rests with the three caudal segments elevated, and the anal prolegs held at right angles to each other. When walking, the same segments remain elevated, the anal prolegs being non-functional.

The young larvae were offered alfalfa, bur clover and *Melilotus*, all of which they refused.

John A. Comstock

PROCEEDINGS OF THE ACADEMY

September 20, 1957

The first meeting of the 1957-1958 Academy year was held at the Southwest Museum. Dinner was served at the museum's historic Casa de Adobe. The occasion was one of mutual commemoration, as the Southwest Museum, like the Academy, is celebrating its 50th anniversary in 1957. Members of both groups were closely associated in the early days.

Approximately 167 members and guests assembled in the museum's lecture hall at 8 P.M. for the program, which was presented by the Academy's Section on Anthropology. The speaker, Dr. Joseph Birdsell, Professor of Anthropology at the University of California Los Angeles, spoke on the subject of "Some Population Problems Involving Pleistocene Man."

A brief summary of Dr. Birdsell's talk before the Academy:

The intrinsic rate of increase for man at simple economic levels of culture for four human population experiments indicates a doubling of the population in each generation. For Australian aborigines the intervals between generations is 16 years. In a model to determine the order of magnitude of time required to originally populate that continent the budding off of colonies is assumed to begin at 40, 60, or 80 per cent of the saturation population. The size of the colonizing unit has been assumed as 5, 25, and 125 persons. Making corrections for the altered topography, climate, extractive efficiency, and densities for a Late Pleistocene period of time, it is calculated that by population pressure alone the best estimate of the duration required for the populating of Australia ranges between 845 years to a maximum of 4,134 years. The most likely combination of variables gives 2,202 years for the entire process. Extrapolating from these data and conditions, it is considered that the Australopithecines may have required as litte as 23,000 years to spread without direct migration from South Africa to Southeastern Asia.

October 18, 1957

The October meeting of the Academy was held at the Los Angeles County Museum under the auspices of the Section on Botany. Fifty members and guests enjoyed an address by Dr. Bernard O. Phinney, Associate Professor of Botany, University of California at Los Angeles, on the subject, "The New Growth Substance for Higher Plants—the Giberellins." Dr. Phinney's talk was followed by a period of enthusiastic questions and discussion.

Abstract of Dr. Phinney's Talk

"A New Growth Substance For Higher Plants — The Gibberellins"

The gibberellins are a class of chemically known substances that have remarkable growth-promoting properties in higher plants. Depending on the particular species and variety of plant, greatly increased vegetative growth with appreciable increases in yield have been observed; many biennial plants respond by flowering the first year. The gibberellins have also been shown to break dormancy in potato tubers and to hasten flowering in certain species of economic importance. The known gibberellins, *gibberellin* A_1 ($C_{19}H_{24}O_6$), *gibberellin* A_2 ($C_{19}H_{26}O_6$), and gibberellin A_3 ($C_{19}H_{22}O_6$), are produced in relatively large amounts by the fungus, *Fusarium moniliforme (Gibberella fujikuroi)*. These gibberellins have not been found in any other fungi or in higher plants. However, "gibberellin-like" substances have recently been obtained from the young seed or fruit of a number of flowering plants. They have the same biological properties as the known gibberellins produced by the fungus. The presence of such naturally-occurring substances suggests that gibberellins or "gibberellin-like" substances may be natural regulators of growth in higher plants.

New Members Elected

The following were elected to membership in the Academy in October:
ANTHONY, Mrs. Lester, 248 Gabriel Court, Sierra Madre (Entomology)
BUTTS, John William, 417 Redondo Blvd., Long Beach (Social Science)
FIERSTINE, Harry L., 11611 Montana Ave., L.A. 49 (Jr. Member) (Paleontology)
GILLOGLY, Lorin Ray, 10256 O'Dell Ave., Sunland (Entomology)
GROVES, Miss Eleanor, 152 West Fairview, San Gabriel (Education)
MATTOX, N. T., Dept. Biology, U.S.C., Los Angeles 7 (Zoology)
PERDUE, Robert F., 209 B West Fairview, San Gabriel
STARRETT, Andrew, Dept. Biology, U.S.C., Los Angeles 7 (Zoology)
SAVAGE, Jay M., Dept. Biology, U.S.C., Los Angeles 7 (Herpetology)
UDEY, Edwin C., 1313 South Bundy, L. A. 25 (Biology)

Section Meetings

Several of the scientific sections of the Academy have indicated a desire for greater activity this year. The Sections on Botany and on Earth Sciences have issued invitations to all scientists in these fields, in the area, to participate in section meetings. The Conservation Committee, also, has in mind a program that may involve considerable activity among participants.

Section on Earth Sciences

An organizational meeting of the Earth Sciences Section was held informally on October 2, 1957, and began with dinner at Carl's Restaurant for some, then adjournment to the Los Angeles County Museum.

Fifteen members and friends of the Academy were present. Drs. Frank E. Peabody and Theodore Downs, "co-chairmen," led a discussion of aims and future plans of the section. It was stressed that section meetings would be designed to interest the active researcher in paleontology, geology and

biology. During the latter half of the meeting, the chairmen led an informal discussion on the "Evolution of the California Landscape and its Effect on the Origin and Dispersal of Vertebrates." The lively audience response was gratifying to the section's expressed aim of stimulating a wide segment of researchers with a unifying theme—in this case, "The Geological and Biological Evolution of Western North America."

November 15, 1957

Fifty members and guests assembled at the Los Angeles County Museum for the November program, sponsored by the Conservation Committee. The speaker, Mr. William Drake, Western Representative of Nature Conservancy, gave a stimulating talk on "Current Progress of Nature Conservancy in California."

Abstract of Remarks by William Drake.

The Nature Conservancy is an offshoot of the Ecological Society of America, and is now engaged in a nation-wide program to preserve natural areas of scientific value. A regional office, serving 11 western states, Hawaii, and Alaska, has been established in Berkeley. This work involves making an inventory of types of areas urgently in need of preservation, locating desirable sites, and acting to get them set aside. Properties are accepted as gifts, or money may be raised to purchase them, or government agencies may be approached for action. The Nature Conservancy owns and operates some areas, but also acts as a go-between agency to acquire areas and turn them over to other institutions. Among many areas owned by the Conservancy in eastern states are an island in Lake George, New York, a bald cypress swamp in Maryland, a bog in Connecticut. In California the Conservancy is attempting to preserve a 3000-acre tract of virgin Douglas-fir forest in Mendocino County, which covers an almost completely undisturbed watershed. Other projects are wildflower areas in Kern County and vernal pools in the San Joaquin valley. The Conservancy also sponsors a project for natural areas for schools. There are many interesting problems concerning the proper management of nature preserves to protect undisturbed conditions. Scientific research is needed in management techniques, and we need to define clearly our purposes in preserving such areas.

The Board of Directors convened following the program, with Dr. Fred S. Truxal, first vice president, presiding in the absence of the president. It was agreed to hold the annual meeting, of May 10, 1958 at the Los Angeles County Museum. Dr. Joseph Kaplan, Director of all United States activities connected with the International Geophysical Year, will be the speaker. Facilities to accommodate a large crowd will be necessary for this outstanding program.

The following new members were elected:

Carpenter, Bruce H., 2403 Via Lucia, Montebello (Entomology); Hoshizaki, Mrs. Tak, 565 N. Westmoreland, L.A. (Botany); Kent, William E., 6740 Milner Rd., L.A. 28; Mangum, Delmer E., 302 Orizaba, Long Beach (Entomology); Morris, Dr. William J., 4945 Rupert Lane, La Cañada (Geology); Rainey, Dr. Dennis G., Long Beach State College (Mammalian Ecology); Schuierer, Frederick W., Dept. Biology, U.S.C. (Vertebrate Zoology); Sleeper, Dr. Elbert L., Dept. Biology, Long Beach State College (Entomology); Vanderwal, Dirk J., 444 Newton St., San Fernando (Agronomy).

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ACADEMY of SCIENCES

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MISCELLANEOUS BULLETINS issued under the imprint of the Agricultural Experiment Station, 1897 to 1907. *Ten numbers.*

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The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

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A List of North American Lepidoptera in the Los Angeles County Museum. Part I Butterflies (Suborder Rhopalocera), Lloyd M. Martin and Fred S. Truxal. L.A. County Museum Science Ser. #18. Zool. #8, 1955. Price $1.00 (add 15 cents for tax and mailing).

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Southern California Academy of Sciences

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LOS ANGELES, CALIFORNIA

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Issued May 28, 1958

Southern California Academy of Sciences

OFFICE OF THE ACADEMY

Los Angeles County Museum, Exposition Park, Los Angeles 7, California

Bulletin, Southern California Academy of Sciences

VOLUME 57 - - - - - - - PART 1, 1958

THE BRAIN CHORIOID PLEXUSES OF GANOIDS AND TELEOSTS

By WILLIAM A. HILTON

(Dep. Zoology, Pomona College)

In ganoids and teleosts there is less indication of internal brain folds than in elasmobranchs. There may be an extensive, thin, membranous development in the roof region of the third brain ventricle which pushes out laterally and forward, hardly a plexus, it is so thin and not very vascular, but there are invaginations into the brain cavity.

Ventral to the brain and in the region of the pituitary in lower vertebrates, especially in elasmobranchs, but also in many fishes are structures, little sacks attached to the brain called saccus vasculosus, Johnston 1906 and Norris '41.

In ganoids the roof of the fourth ventricle may have thickened glandular extensions as in Lepidosteus described by Chandler 1911. Similar lymphoid or glandular swellings in this region are found in a number of forms, especially perhaps in Amia. The inner side of the roofs of the fourth ventricle of Lepidosteus and Amia have a number of folds, similar to those found in sharks but not so marked.

In all the teleosts examined a plexus in the roof of the fourth ventricle is quite different from that of cyclostomes and most elasmobranchs. It is less conspicuous and less extensive and more a network of large vessels than small ones. According to Sagemehl '84, Sterzi '00- '01 and some others, the membranes about the brains of fishes are not dura, arachnoid and pia as in amphibians, reptiles, birds and mammals but a more or less undifferentiated *meninx primitiva*.

Quite a characteristic covering of teleost central nervous systems is a thick adipose layer, not like the lymphoid or glandular masses of ganoids but a true fat which may be highly vascular. This covering is considered to be a part or a modification of the meninx primitiva.

I found no internal chorioid plexuses in the brains of ganoids and teleosts, nor was there any hint of them in the literature.

In fishes and some other vertebrates, the roof of the third ventricle in front of the habenula has a plexus, the parencephalon. In fishes sac like structures may be formed in this region, such

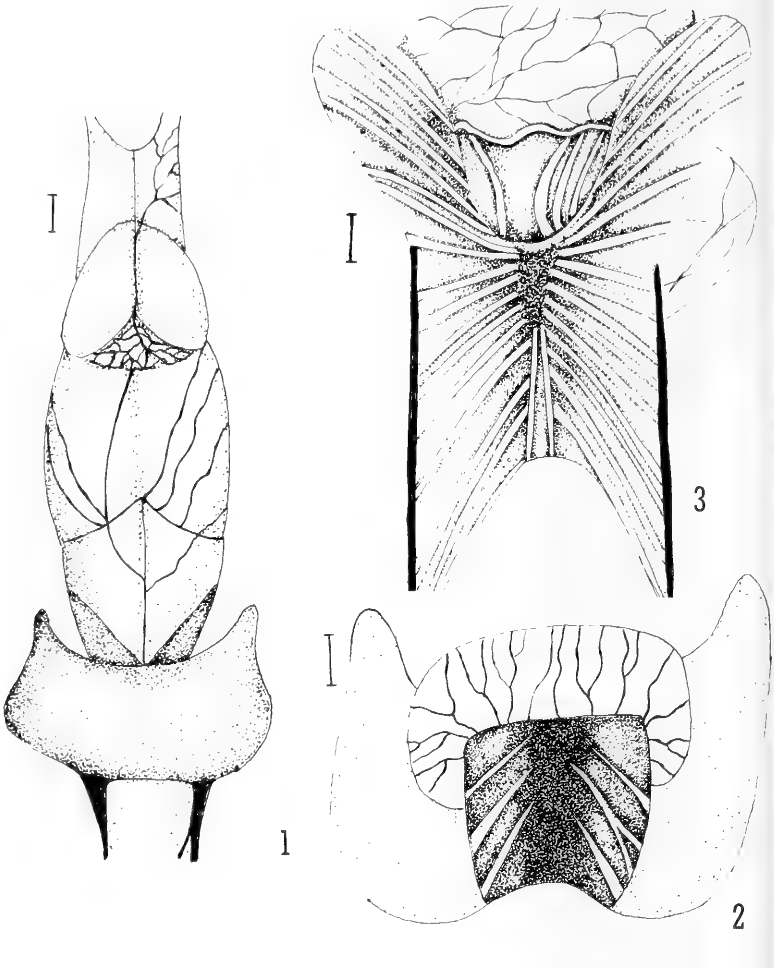

PLATE 1

as described by Hocke Hoogenbloom '29 in Polydon. In Lepidosteus and Amia such sacks reach great size and extend dorsally and lateraly and even frontally. Kingsbury '97, Ariens Kappers '07. These were not especially studied at this time.

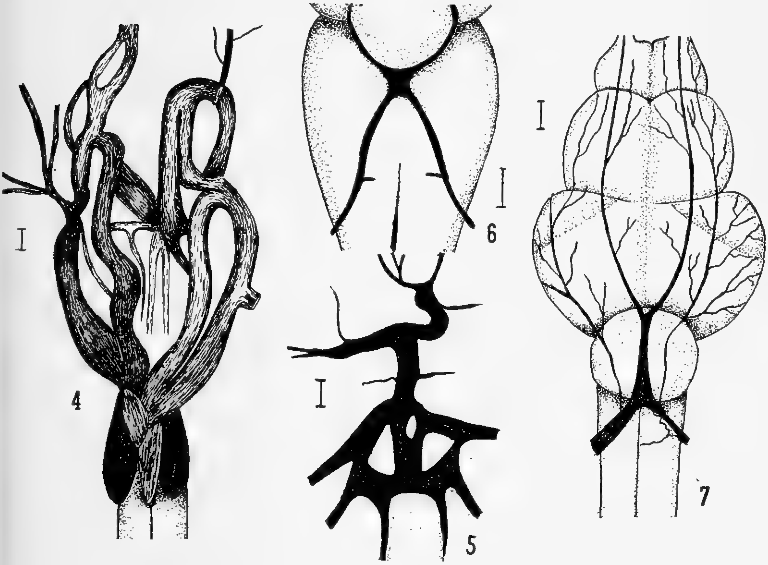

PLATE 2

EXPLANATION OF FIGURES

The scale equals one mm. The upper or cephalic end is at the top in each case.

1. Brain of Lepidosteus above. Only a little of the third ventricle plexus is shown. All cephalic, lateral and caudal extensions removed. Swelling over the fourth ventricle shown.
2. Inner view of the roof of the fourth ventricle of Lepidosteus.
3. Inner or under view of the roof of the fourth ventricle of Amia.
4. Blood vessel loops in the region of the fourth brain ventricle, Ameiurus.
5. Blood vessels in roof of the fourth ventricle of Anguilla.
6. Blood vessels in fourth ventricle roof of Peroa.
7. Chief veins on the dorsal side of the brain of Paraliohthys.

SUMMARY

1. In ganoids and teleosts no invaginations of chorioid plexuses into the brain cavities were found.

2. The invaginations were in the region of the third brain ventricle in a dorsal position, in the region of the pituitary in some cases and especially in the roof of the fourth brain ventricle. Only the last are shown in the figures.

3. Lymphoid lobes on the dorsal and lateral parts of the roof of the fourth ventricle are found in ganoids, those studied were of Amia and Lepidosteus.

4. Folds on the inner sides of the roof of the fourth ventricle are shown in Lepidosteus and Amia. In the latter the form and appearance below is much as in many elasmobranchs.

5. In teleosts under the mass of vascular fat which covers the brain in many cases, heavy blood vessels, sometimes with a coarse plexus may be found in the roof region of the fourth ventricle, a condition found rarely among elasmobranchs.

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NEW RECORDS OF CENOZOIC AMPHIBIANS AND REPTILES FROM CALIFORNIA

By BAYARD H. BRATTSTROM*

While examining fossil amphibians and reptiles in various museums several specimens were found that add to our knowledge of the herpetofauna of certain paleontological sites in California. This new material comes from Eocene, Miocene, and Pleistocene deposits and represents specimens in the collections of the University of California and the Los Angeles County Museum including the recently acquired collection of the California Institute of Technology. The material will be discussed by age and locality.

EOCENE

Poway Conglomerate

Amyda sp.

From C.I.T. Locality 249, Eocene, Poway Conglomerate, Cliff on West side of San Diego River, approximately ¼ mi. N.E. of the San Diego Mission, San Diego County, California, there are eight fragments of a soft-shelled turtle. The species is unidentifiable due to the fragmentary nature of the material. It is of interest, however, first to record this turtle for the Eocene of California and second to add it to the fauna of the Poway Conglomerate.

Sespe Formation

Amyda sp.

A fragment of a soft-shelled turtle was found in collections made for the University of California by R. H. Tedford from Brea Canyon Site Number 3, (U.C.V. 5242).

Testudo sp.

A fragment of the carapace of a large tortoise from C.I.T. Loc. 180 is mentioned here only to add a tortoise to the fauna of the Eocene of California and to Locality 180. It is unidentifiable as to species.

Saniwa brooksi Brattstrom

Thirteen vertebrae, 10 of which are caudals, come from C. I. T. Loc. 180. They do not differ from *S. brooksi* as described by the writer from the Poway Conglomerate. Measurements made on the

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three thoracic vertebrae include: Centrum ball height and width: 4.7-8.3, 2.7-5.5, 3.3-5.9; measurements on the largest vertebra include: width of vertebra, 10.7; width across prezygapophyses, 15.2; width of process of prezygapophysis, 4.6 mm.

A portion of a maxilla containing one tooth is also included in this material. The fragment measures 10.3 x 8.9 mm. and the tooth is 3.0 mm. high and 3.0 mm. wide. The fragment may be from a *Saniwa*.

Lizard sp.

Additional lizard material from the type locality of *Peltosaurus macrodon* (C.I.T. Loc. 180) includes 12 pieces of body plates and four fragments of jaws with teeth. The teeth in the four bones are not beveled, but elongated and pointed. The material at hand is unidentifiable at present.

Boavus affinis Brattstrom

Some 24 additional vertebrae of this species have been found since its original description. The material comes from the same locality as the Type and Paratypes (C. I. T. Loc. 180 and 202) and from one additional locality (C. I. T. 150). The vertebrae are all similar to the Type with regard to the centrum keel and depression, zygosphene, and the relation of the centrum keel to the ball. In 7 of the vertebrae the centrum keel does not touch the ball, but these vertebrae are somewhat worn and this condition may have resulted from weathering. Ranges of measurements of all known thoracic vertebrae of *Boavus affinis* include: vertebrae height: 13.7-24.9; vertebrae width: 8.5-19.5; centrum length: 5.8-14.0; width across prezygapophyses: 13.5-22.1; width across postzygapophyses: 15.0-20.9; height of neural spine: 5.2-8.7; width of neural spine 6.6-6.8 mm.

MIOCENE

Barstow Syncline

Charina prebottae new species

Type: University of California, Museum of Vertebrate Paleontology, number 45242, consisting of two mid-thoracic vertebrae.

Type locality and age: Upper Miocene, Barstow formation, Barstow Syncline, San Bernardino County, California, collected by R. H. Tedford and R. L. Schultz.

Diagnosis: A *Charina* of the same size as the recent *C. bottae* and differing from it only in the following details: Area between forks on the anterior edge of zygosphene rounded when viewed from above; neural spine very small and forked anteriorly; anterior edge of neural spine descended to the dorsal surface of the zygosphene—not indented laterally.

Description of type: the type consists of two, small, low, mid-thoracic vertebrae. The neural spine is very small in height, width, and length. It is forked anteriorly and the anterior edge descends to the dorsal surface of the zygosphene and is not undercut. The

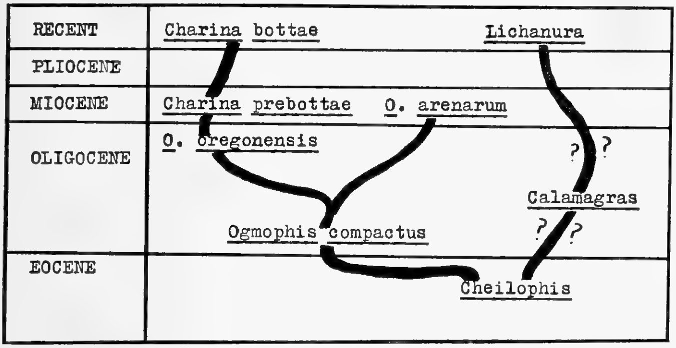

PLATE 3

Diagram showing possible relationships of several North American Cenozoic boids based on similarities of thoracic vertebrae.

zygosphene is flat on top with the lateral edges slightly rounded. The anterior edge of the zygosphene, between the anterior-lateral extensions or forks is slightly curved forward. The subcentrum keel is flat, smooth, and bordered laterally by a weak flat area. The keel does not touch the ball but stops in a point before reaching it. The cup is rounded and slightly slanting ventrally. The prezygapophyses are raised slightly above the horizontal.

DISCUSSION: *Charina prebottae* is most closely related to the Recent *C. bottae,* from which it differs only in details. The anterior edge of the neural spine is not undercut as in *bottae.* The zygosphene in *bottae* has a flat rather than a curved anterior edge. The subcentrum keel of *bottae* usually just touches the ball and is only slightly pointed. The genus *Charina* differs from the fossil genus *Ogmophis* only in a few details. Among members of that genus, *C. bottae* and *prebottae* resemble *O. oregonensis* of the Upper Oligocene, John Day region of Oregon. Unfortunately the type of O. *oregonensis* is lost and the species is known only from the original description and poor figures. *Charina* differs from *O. oregonensis,* however, in having a small, stubby neural spine. *Charina* differs from O. *arenarum* of the Miocene of Montana in that the latter has a transversely ovate cup. *Charina* differs from *O. compactus* of the Oligocene of Canada in having an oblique ball and an interzygapophyseal ridge (absent in *O. compactus,* but presents in *Charina* and the other *Ogmophis*).

The genus *Calamagras* was retained as distinct from *Ogmophis* by Gilmore (1938) primarily on the basis of the sub-centrum keel, long foramen lateral to the keel, and the shape of the neural spine. *Calamagras* vertebrae are similar to *Lichanura* and the two may be related. The ancestor of the genera *Ogmophis* and *Calamagras* is unknown at present. The questionable *Cheilophis* of the Eocene

of Wyoming is similar in basic type to *Calamagras.* Some of these similarities of vertebrae are diagrammatically shown in Plate 3.

PLEISTOCENE

Potter Creek Cave

In 1953, Brattstrom described a new species of rattlesnake from Potter Creek Cave in Shasta County, California. Since then additional herpetological material from this cave has been found in the collections of the University of California. This includes:

Bufo boreas Baird and Girard

Toad material from Potter Creek Cave comes from depths of a few inches to 60 inches and includes entire and fragmentary humeri and tibia-fibulas. The bones are all from large individuals. The humeri are sligthly more robust than Recent *B. boreas* and the ridge at the distal end of the humerus is small or absent. There is some variation in this ridge in skeletons of Recent *B. boreas.*

Clemmys sp.

There are several fragments of *Clemmys* from this cave. The fragments are unidentifiable as to species but probably represent *C. marmorata.*

Crotalus potterensis Brattstrom

This species was described from two vertebrae. Since then some 34 additional *Crotalus* vertebrae have been found in the University of California collection. These vertebrae, unlike the type, have depth data with them. The *Crotalus* vertebrae were found from depths of several inches to 140 inches. Measurements were made on these 34 vertebrae of the various characteres used by Brattstrom (1953b, 1954b). These characters are tabulated by depth in Plate 4. On the basis of the critical characteristics of *C. potterensis* (centrum length, neural spine width, width of postzygapophysis process, width across postzygapophyses) it appears that the vertebrae from the lower (older) levels of the cave (140-80") are more like *C. viridis* than *potterensis.* Vertebrae from intermediate levels (60-40") are intermediate between *viridis* and *potterensis* and the vertebrae from the upper levels (30-4") are potterensis-like. This would suggest that the divergence of *potterensis* from a *viridis* stock is visible within the cave material and that *potterensis* diverged from *viridis* at a time in the past represented by the 40-60 inch level in the deposit. Unfortunately we do not know the rate of deposition of the cave material nor the exact age of the cave. In addition this apparent divergence is based on only a few vertebrae.

Assuming that a rattlesnake of large size can live only in a warm or hot climate (*i.e.* in a cool climate a large rattlesnake

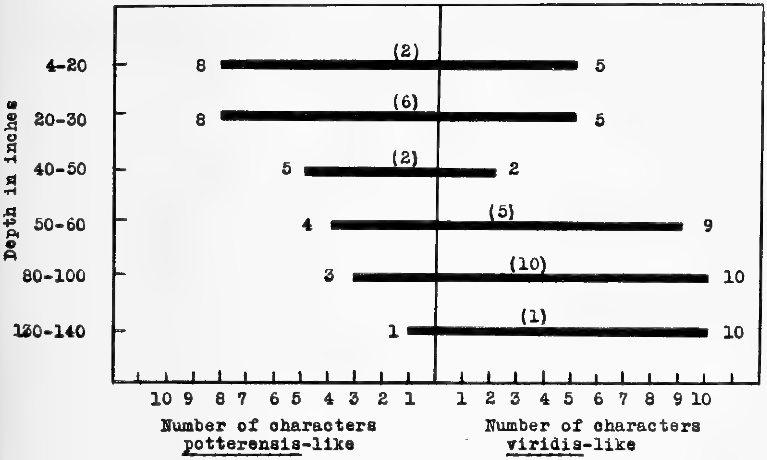

PLATE 4

Graph showing changes in number of characters of *Crotalus* vertebrae in Potter Creek Cave correlated with depth. Number of vertebrae at each level indicated above bar. The characters used are those of measurements as used by Brattstrom, (1953a, 1954b).

could not heat its body to optimum levels) the changes in size of rattlesnakes from small to large within Potter Creek Cave suggests an increase in general environmental temperature in the more recent deposits. Extinction of *potterensis* may be related to the climate becoming too warm or to a subsequent rapid cooling. Unfortunately we do not know the exact age of Potter Creek Cave. It may be just preglacial or postglacial.

Mescal Cave

A collection of fossils from Mescal Cave, Mescal Range, San Bernardino County, California, is in the Museum of Paleontology, University of California. The total fauna of the cave is unreported upon, but the cave deposits are probably of a Late Pleistocene age. According to Keith Murray (personal communication) the mammals from the cave include a marmot, pika, *Citellus lateralis*, a *Microtus*, and probably *Neotoma cinerea*. These mammals suggest a climate cooler than that at the site of the cave today (see Johnson, Bryant, and Miller, 1948). Among the reptiles from the cave deposits, two forms (*Sceloporus occidentalis*—which occurs at the site of the cave today as a probable relic, and *Crotalus viridis*—which does not occur in the Mescal Range today) conform with the mammal data suggesting a cool climate for the deposit. Several of the desert reptiles now living around the fossil site (see Johnson, *et. al. supra cit.*) also occur in the cave

deposits. The latter may be from more recent deposits, but unfortunately no stratigraphic data are available. The herpetofauna of the deposit includes:

Gopherus agassizi (Cooper)

A broken portion of an epiplastron of *G. agassizi* was found in the cave. It measures 55.3 mm. along its outer margin and 36.0 mm. long at the gular sulcus.

Sceloporus occidentalis Baird and Girard

Eleven fragmentary or entire dentaries, one complete lower jaw, and four fragments of maxillae do not differ from recent *Sceloporus occidentalis.* The flat area lateral to the teeth on the dentary, the posterior process of the dentary, the shape of the coronoid, and the flat portion of the maxillae all indicate that these bones are of *S. occidentalis* and do not represent any of the other *Sceloporus* in the southwest (*magister, graciosus, clarki, orcutti,* etc.).

This species occurs at the site of the cave today (Johnson, Bryant, and Miller, 1948) as a population isolated from the main range of the species.

Cnemidophorus cf. *tigris* Baird and Girard

One dentary with 24 teeth sockets has bilobed teeth. The larger lobe is somewhat obtuse and squatty, not elongate and acute as in Recent *C. tigris* skeletons. The teeth are larger than in Recent *C. tigris.* Other Pleistocene *C. tigris* (Brattstrom, 1954a) seem to have these same kinds of characters. Measurements on the dentary include: length: 13.1; width 3.2; distance between posterior tooth and last foramen: 4.3; distance between last two foramen: 1.4 mm.

Crotaphytus sp.

Two separate fragments of large lower jaws are referred to this genus. One, a fragment of a dentary, is unidentifiable other than it resembles the other fragment. The latter has a dentary, coronoid, and parts of the splenial and articular. This jaw is similar in general shape (especially coronoid shape and curvature, and the edges around the post-coronoid foramen) to *Crotaphytus* and especially to *C. (Gambelia) wislizeni.* In certain characters (post-coronoid foramen bordered below by coronoid, low lateral coronoid knob) it resembles *C. (Crotaphytus) collaris.* It differs from both these forms in having the coronoid and articular margin of the posterior dentary process lower on the jaw and extending farther posteriorly, in the presence of a medial coronoid knob or ridge continuing medially and ventrally, and in having a posterior-medial edge on the elevated part of the coronoid. The characters of the coronoid, the most distinctive feature of the fragment, do

not agree with any of the other North American genera of Iguanids. The distinctive features of the fragment are sufficiently diagnostic for recognition of a new species, but due to the small and fragmentary nature of the fossil, description is withheld until further material comes to light.

Crotalus viridis (Rafinesque)

There are 33 vertebrae from this cave that do not differ from modern *Crotalus viridis* in shape or measurements. Many of the vertebrae are connected and connective tissue is still present on some of them.

This locality is outside the present range of *C. viridis,* but its occurrence here is not surprising as the species has been recorded from Gypsum Cave, Nevada (Brattstrom, 1954a) to the northeast. The range of *C. viridis* was probably widespread across much of the present day desert in Pliocene and possibly cool Pleistocene times as suggested by the present distribution of the species and the available fossils (Brattstrom, 1954a, 1954b). With Pleistocene or maybe even post-glacial times the range of the species apparently became restricted away from desert areas. Perhaps certain populations became isolated in several mountains in the developing desert region (Ex. Mescal Range) and became extinct there as desert climates moved up the mountains.

Schuiling Cave

The fauna of Schuiling Cave, approx. 11 mi. S. E. of Daggett, Newberry Mountains, San Bernardino County, California, was reported on by Howard and Downs (San Bernardino Co. Mus. Ass'n Bull, March, 1956). The fauna includes several kinds of ducks, a coot, avocet, extinct condor, Golden eagle, red-tailed hawk, mourning dove, horned owl, flicker, raven, and the following mammals: *Perognathus, Neotoma, Taxidea, Urocyon, Equus* (2 species), large camelid, *Tanupolama,* and *Breameryx.* The only reptiles from this cave are:

Gopherus agassizi (Cooper)

Tortoise material from this cave in the Los Angeles County Museum includes LACM 1996.0–.73 (shell fragments and limbs; various depths), 1997.27 (shell fragments, various depths), 1557 (shell fragment, 48″ deep), and 1553 (partial carapace).

Sauromalus obesus Baird

Chuckwalla material from Schuiling Cave includes three vertebrae from depths of 6′3″ (LACM 1979), 3′6″ (1999), and 40-50″ (3002), and one occipital from 5′8″ (1573). The vertebrae do

not differ from Recent *Sauromalus obesus* in size and shape. The ventral shape of the centrum with its heavy, flattened subcentrum keel bordered laterally by grooves and ridges, gives a triangular appearance to the ventral surface of the vertebrae. The size of the vertebrae and the shape of the subcentrum keel eliminates all southwestern Iguanids except for the chuckwalla. Measurements of two of the vertebrae are: centrum length: 5.8 and 8.6; width across prozygapophyses: 7.9-8.8; width across postzygapophyses: 6.8 and 8.5 mm.

Rancho La Brea

While working as an assistant to Theodore Downs of the Los Angeles County Museum during the Summer of 1956, I had the occasion to move about certain portions of that museum's La Brea collection. In doing this, several additional herpetological specimens from the La Brea tar pits were found. The material is primarily of interest in recording additional pit-data for certain species.

Clemmys marmorata (Baird and Girard)

Many boxes of bones of this pond turtle were found and apparently include portions of some 126 individuals. These turtles come from pits (with the number of individuals in parentheses): 3(8), 4(38), 9(2), 16(48), 36(4), 60(3), 61(6), 67(10), 77(1), 81(1), 0(5). Some of these turtle bones had specific depth data on them. This is presented here for the record. Pit 3/5-8′; 3/F5,8′; Pit 4/F45,12-13′; 4/F45,17-20′; 4/B4,13′; 4/8′; Pit 9/near surface: 9¾2-8′; Pit 16/6-8′; 16/0-2′; Pit 60/C13,13′; Pit 61/D15,14-17½′; Pit 67/C8,17-18′; 67/F10,14½-15½′.

Coluber constrictor Linnaeus

Vertebrae of this species come from pits 37, 36, 10, and 10D. This species was only tentatively referred to by Brattstrom, (1953a).

Lampropeltis getulus (Linnaeus)

Three additional vertebrae of this species come from pits (one each): 10, 28, 37.

Crotalus viridis (Rafinesque)

Additional material of this rattlesnake comes from the following pits: 10, 10D, 28, 31, 36, 37, 67, 81. The one vertebra from pit 31 is quite large for this species.

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FOSSIL ARTHROPODS OF CALIFORNIA. No. 21. TERMITES FROM CALICO MOUNTAINS NODULES.

Drawings by author. Photos by George Brauer.

INTRODUCTION

This is the first of a series of papers that will be presented on the Miocene Lake bed nodules from the Calico Mountains, San Bernardino County, California.

In 1954 I first read newspaper clippings about the finding of fossil insects in lacustrine deposits in the Mojave Desert. On August 6, 1954, Allison R. Palmer and Allen M. Bassett published a brief note on Nonmarine Arthropods from California, in Science, vol. 120, pp. 228, 229. In May 1955 I had the privilege of seeing some of these interesting fossil insects in Dr. Palmer's office in Washington, D.C. His official report on these nodules and the contained insects is in press.

Early in 1956 Mr. and Mrs. John H. Rouse called on me to show some fossil insects in nodules they had found in the Calico Mountains. They were unaware of the earlier findings of Palmer and Bassett. Since then they have made frequent trips to collect nodules. These have also been collected in the Calico Mountains by entomologists from the University of California at Riverside, and by Mr. and Mrs. Sam Kirkby, also of Riverside.

I have made two trips to the area in the company of Los Angeles County Museum personnel and others. The first was on May 10 and 11, 1956, with George P. Kanakoff, Curator of Invertebrate Paleontology at the Museum, accompanied by Rostick Ryshkoff, Dara Shilo, Jeanne Hotchkiss, Mr. and Mrs. John G. Carr, and Mr. and Mrs. Rouse. On that trip we acquired for the Museum 4153 nodules from several sites in different canyons.

On April 12-14, 1957, our second party of 14 persons consisted of myself, George P. Kanakoff, and Rudolph Pesci of the Museum; Dr. Richard E. Loomis and Delmer Mangum of Long Beach State College; Mr. and Mrs. John G. Carr, Mr. and Mrs. Charles Artman, and Ralph Ackerman, and four students, Wilma Webster, Judy Clark, Sheryl Weber, and Elza Kops.

As a result of these trips and supplementary specimens received from Mrs. Rouse and Mrs. Kirkby, the Museum collection has reached a total of 10,266 specimens. These were collected at 38 sites in 109 separate lots, in 9 different quarter sections of the Yermo Quadrangle. Details of our findings will be published after the release of Dr. Palmer's report. Inasmuch as he is not reporting on termites, I am free to report on these at this time.

Only five Miocene termite species have been previously reported from the United States, and these are listed in the new list at the end of this article.

DESCRIPTIONS OF FOSSIL–BEARING NODULES

It is my pleasure to report the finding of ten nodules with termite wing impressions, all in Switchback Canyon in NE ¼ and NW ¼ of Section 19, Yermo Quadrangle, but at 5 different sites in the canyon, all at altitudes of 2700 to 3000 feet. The nodules are of entirely different types and formation, so that we can assume at least four different conditions of deposit.

The LACMIP sites are registered as Los Angeles County Museum Invertebrate Paleontology sites.

Site 10 (LACMIP 357) in NE ¼ Sect. 19, which we called the Rouse anticline, is located at the Switchback, upper level, altitude about 2700 feet. Here a great number of annual strata lie in a sharp anticline fold. Inasmuch as the annual varves are between 20 and 25 to the inch, and the deposit is over 10 feet thick, there is at least a 2400-year deposit of nodules. Nodule No. 1365, a yellow disc, containing Specimen 505, was found by Rostick Ryshkoff, May 10, 1956. It weighs 40.5 grams, and measures 48 x 34 x 19.5 mm., broken on one side, so that original size was probably 48 x 41 x 19.5 mm. It was formed of 7 or 8 layers and may

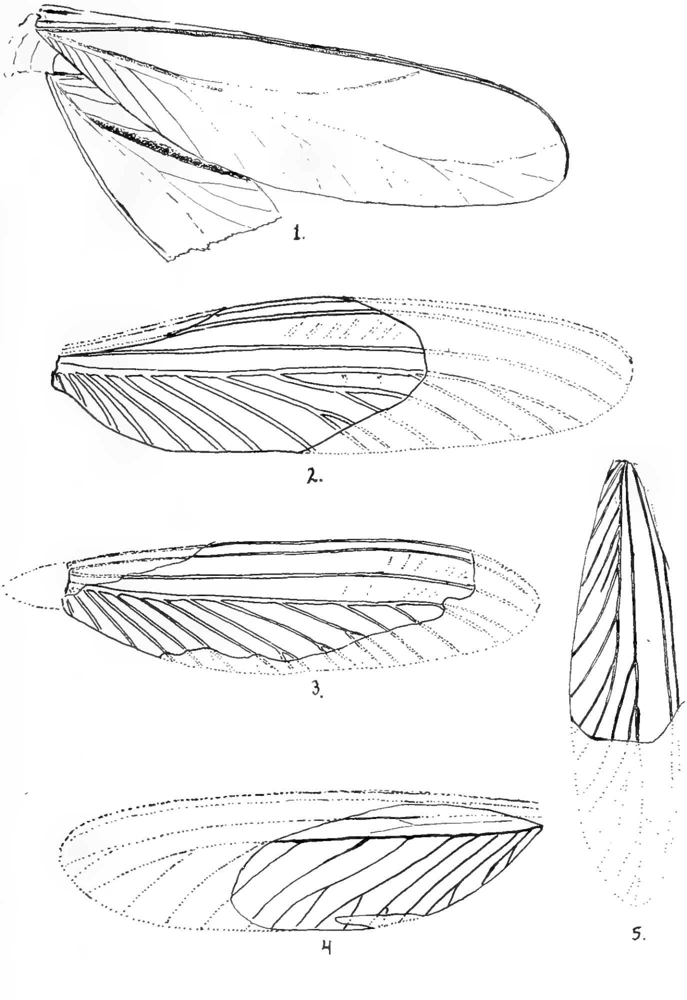

PLATE 5

1. Wing Pattern, *Cryptotermes ryshkoffi* n. sp., Specimen 505.
2. Wing Pattern, *Parastylotermes calico* n. sp., Specimen 553.
3. Wing pattern, *Reticulitermes laurae* n. sp. Specimen 912.
4. Wing pattern, *R. tibialis dubitans* n. sp., Specimen 376.
5. Wing pattern, *Gnathamitermes magnoculus rousei* n. sp., Specimen 362.

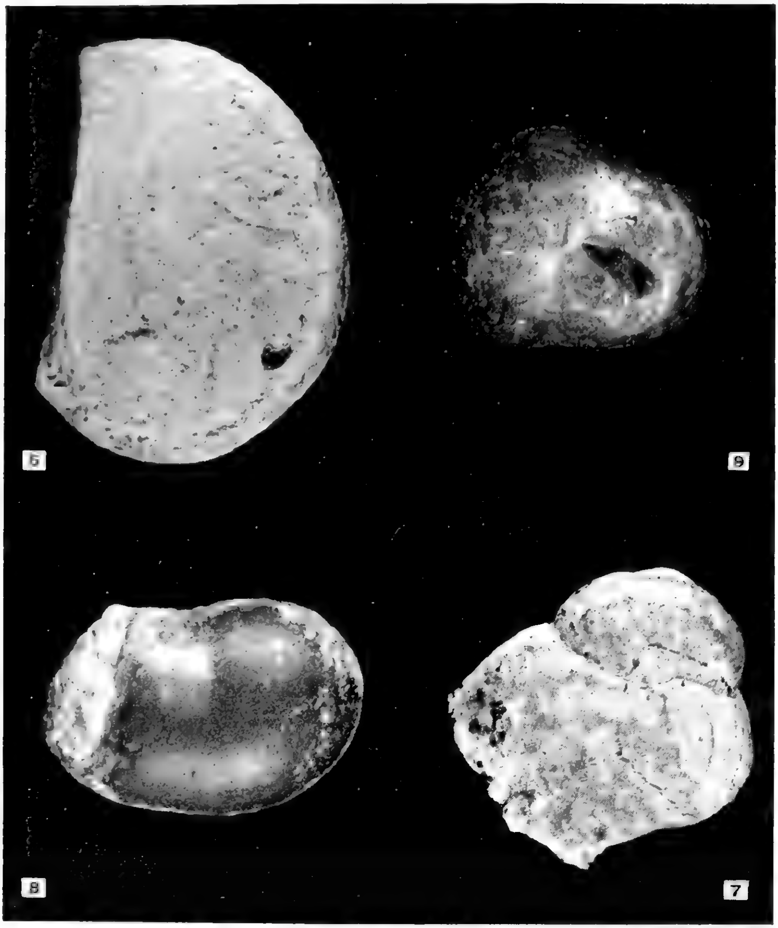

PLATE 6

6. Nodule 1365 showing specimen 505, *Cryptotermes ryshkoffi* n. sp.
7. Nodule 5485 showing specimen 553, *Parastylotermes calico* n. sp.
8. Nodule 4142 showing specimen 494, *Reticulitermes laurae* n. sp.
9. Nodule 4067 showing specimen 362, *Gnathamitermes magnoculus rousei* n. sp.

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have been a rolling disc which settled in a water depression, and on which as the last coat was being added, in the final matrix, a termite body was included in the upper layer. (Figure 6).

Site 25 (LACMIP 373), also in NE ¼ Sect. 19, is an upward extension of the Rouse anticline, altitude 2725 feet. John Carr found (April 12, 1957) in the matrix, a small mottled gray and white mammillate nodule, No. 4802, with upper portion concave. On the under side is Specimen 547, part of which has been eroded. The complete nodule weighs 3.1 grams, and measures 20 x 19 x 9.5 mm.

Site 24 (LACMIP 372), just over in NW ¼ Sect. 19, is a large dump of white rock in the canyon bed, a very short distance up from the switchback, altitude about 2700 feet. Nodule 5485, found by Wilma Webster, April 12, 1957, is a broken specimen of a bimammillate nodule. It is quite complex in structure, with at least 5 years growth, and the Specimen 553 is inset on the upper surface. The fragment weighs 9.65 grams, and measures 24 x 22 x 19 mm. (Figure 7).

Site 16 (LACMIP 363), farther up the canyon, in NW ¼ Sect. 19, is a borax mine dump, altitude about 2900 feet. Here Mrs. Rouse has found nodules 4066, 4067, 10265, and 10266.

Nodule 4066 is gray blue, layered, mound shape, bearing on its side Specimen 376. The nodule weighs 10.05 grams, and measures 26 x 23.5 x 15 mm.

Nodule 4067 is blue black, bearing on its upper side Specimen 362. The nodule weighs 6.9 grams, and measures 21.5 x 19 x 13 mm. (Figure 9).

Nodule 10265 is gray blue, of very complex nature. It has had several stages of growth, the first stages almost vertical to the last. In the vertical there are at least 8 annual growth layers, and in the last part about 6 annual growth layers. The Specimen 912 lies on the under side of this latest growth (Figure 10). The nodule weighs 49.4 grams, and measures 48.5 x 46.5 x 22.5 mm. On the upper side of the nodule there is also a petrified larva.

Nodule 10266 is also gray blue, mammillated, weighs 12.8 grams, and measures 30 x 22 x 18 mm. The Specimen 913 lies on the side of the nipple beneath. The growth lines are obscure.

At site 16B (LACMIP 364) nearby, Mrs. Rouse found a matrix deposit of horizontal strata, in which were imbedded nodules 4138, 4142, and 10264.

Nodule 4138 is many layered, yellow gray in color, and of inverted bee hive shape, weight 29 grams, measuring 33 x 30 x 27 mm. Specimen 496 was just under the outer ledge.

Nodule 4142 is blue black, shaped like a large bean, weighing 7.4 grams, measuring 25 x 16.5 x 13 mm. Specimen 494 is on a ledge near the end. (Figure 8)

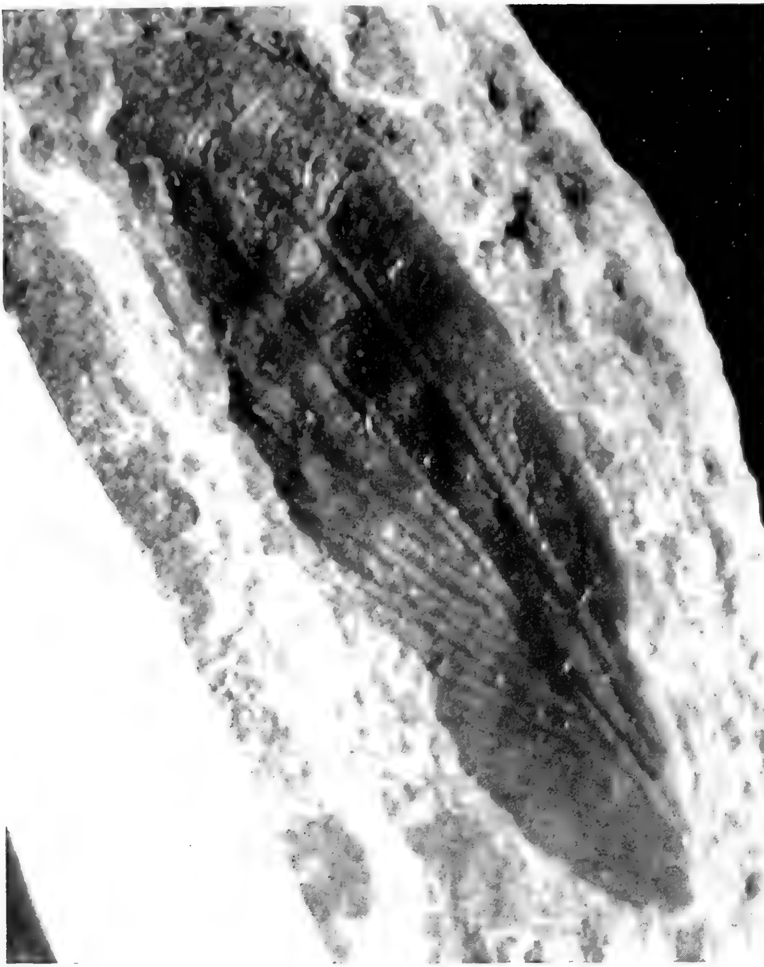

PLATE 7

10. Enlargement of wing of *Reticulitermes laurae*, n. sp., specimen 912.

Nodule 10264 is a gray, layered, round nodule, weighing 11 grams, measuring 24 x 21.5 x 16.5 mm., and giving evidence of about 8 years growth. Specimen 862 is on the upper surface with edges worn to conform to the nodule shape.

All of these nodules apparently originated elsewhere than the matrix in which finally deposited, and it was in the final resting

place that the termite wings fell into the water, and were incorporated on the completing nodule. In each case there is a little ledge built up to the wing impression. Except in Specimen 505 the fossil is a cast of the wing, but 505 is of different color and probably a petrification of the part of the body and the wings.

DESCRIPTIONS OF SPECIES

I determine the wings as belonging to five species in four genera.

KALOTERMITIDAE. KALOTERMITINAE.
GENUS CRYPTOTERMES BANKS.

Cryptotermes ryshkoffi, new species (Figures 1, 6).

Named in honor of Rostick Ryshkoff, who found nodule 1365 on which the specimen occurs, May 11, 1956.

Holotype: Specimen 505 (L.A. County Museum Invertebrate Paleontology Type No. S 9097), a right anterior wing, and a left posterior wing, with three dorsal segments, lying on the upper surface of a disc-shaped nodule. The specimen seems to be actually a petrification of the wings and thorax, as the color is distinct from that of the yellow nodule. When found the costal base was concealed, but by careful needle work it was exposed, clearly revealing characteristics of the genus *Cryptotermes*.

Description: Actual length of anterior wing 10.5 mm., hind wing 9.6 mm. Except at base, venation very faint. Basal costal triangle not well defined. Radius$_{4+5}$ a strong vein from base to apex. Media parallel and close to Cubitus in basal third, sending a curving branch to join Radius $_{4+5}$ at apical third (characteristic of the genus). Cubitus well defined in basal third, faintly beyond. First seven cubital branches clearly defined and unforked. Beyond these the veins are faintly outlined, but I count thirteen branches in all, of which the 10th, 11th, and 12th are forked. Beyond the 12th, Cubitus turns upward to meet Radius $_{4+5}$ at apex. Hind wing complete, but so finely lined that only a few cubital branches are clear.

Only two living species of this tropical genus occur in the United States, neither of them west of Louisiana. The fossil species has a longer wing than either of them, and the venation is distinct.

RHINOTERMITIDAE. STYLOTERMITINAE.
GENUS PARASTYLOTERMES SNYDER.

Parastylotermes calico, new species (Figures 2, 7)

Holotype: Specimen 553 (L.A. Mus. Inv. Paleon. Type No. S 9094) from Nodule 5484, collected by Wilma Webster, April, 1957. An incomplete wing impression.

Description: The specimen is placed in Genus *Parastylotermes* because Media is closer to Cubitus than to Radius $_{4+5}$, and because there are apparently only two basal veins, SC-R and R_{4+5}.

Wing impression measures 7.8 mm., and with typical proportional extension should have measured 12.14 as an entire wing. Cubitus shows 11 branches, and I assume one more to fit the pattern. Of these branches, only the 9th and 10th are forked. As in *P. washingtonensis* Snyder of the Miocene of Washington, several cross veinlets occur between Media and Radius $_{4+5}$. Distinguished from *P. washingtonensis* which measures 11.5 mm., by different Cubital pattern, that species having 13 primary branches, with 3rd, 5th, and 8th forked.

Rhinotermitidae. Heterotermitinae.
Genus Reticulitermes Holmgren.

Reticulitermes laurae, new species (Figures 3, 8, 10)

Holotype: Specimen 912 (L.A. Mus. Inv. Paleon. Type No. S 9095) impression of wing on nodule 10265, collected by Mrs. Laura Rouse in 1957.

Paratypes: Specimen 494 on nodule 4142; Specimen 913 on nodule 10266; Specimen 496 on nodule 4138; and Specimen 862 on nodule 10364, collected and retained by Mrs. Rouse. Though fragmentary all specimens fit to one wing pattern, with same dimensions.

Description: In order to determine the entire wing length, the wing pattern of *Reticulitermes tibialis* Banks, which now occurs throughout the Western United States, was superimposed on scale drawings of the five fossil specimens. In this manner it was possible to extend the veins and obtain an hypothetical picture of the entire wing. The pattern is clearly that of *Reticulitermes.*

The wing pattern in accordance with the terminology of J. H. Comstock is as follows: Costa-Subcosta-Radius a single marginal vein extending entire length of wing. Radius $_{4+5}$ runs parallel to the margin and extends to the apex. Media is a straight vein from base to apex, lying half way between Radius $_{4+5}$ and Cubitus. Cubitus runs parallel to Media, finally curving down to posterior margin near the apex. It occupies slightly more than half the width of the wing, and has 13 branches to the margin, of which the 6th to 10th have short branches. There is more or less indication of transverse reticulation, or cross veins above and below Media.

The largest fragment (holotype) measures 8.9 mm., thus greatly exceeding the entire length of the wings of the three known species of this genus in Southern California. Extending to its full size the deciduous part of the wing should have measured 10.3 mm. The wings of the now existing species measure

as follows: *R. tibialis* Banks 8.4 mm.; *R. flavipes* Kollar fore wing 8.0 mm., hind wing 7.0 mm., *R. hesperus* fore wing 7.2 mm., hind wing 6.9 mm. The Miocene fossil *R. creedei* Snyder fore wing measures 6.5 mm. The Miocene fossil *R. fossarum* (Scudder) had fore wings measuring 7.75 to 9.25 mm.

Aside from size this species is outstanding for the clarity of the venation, all veins being clearly outlined in the fossil casts. The living *R. tibialis, R. hesperus*, and *R. flavipes* have Subcosta and Radius$_{4}+_{5}$, and the basal parts of Media and Cubitus clear, the outer portions very faint. The fossil *R. fossarum* has only the two basal veins clear, all other venation obscure. The fossil *R. creedei* has all venation well defined, but different in character from this species.

Reticulitermes tibialis dubitans, new subspecies (Fig. 4)

Holotype: Specimen 376 on Nodule 4066, collected by Mrs. Laura Rouse, and retained by her.

Description: The wing impression consists of the Cubital area with 1st, 2nd, 4th, 5th, and 6th branches forked, and a short stretch of Media. It is a badly crumbled specimen in the outer portion. The impression measures 6.7 mm., and on the basis of probable extension in the proportions of *R. tibialis,* the length of this wing would be 10.6 mm.

I am placing this large fossil wing in *R. tibialis* because the portion available has the same characteristics of cubital branching found in the living species. In the Banks figure of *R. tibialis* fore wing, the first Cubital is bent as if it had a branch, and the 2nd, 4th and 5th are branched. In the hind wing only the 3rd is indicated as branched. The total number of Cubital branches in *tibialis* is 10, as would seem to be the case in the present specimen. Actual wings of *R. tibialis* studied measured only 8.4 mm. in length.

Although found in the same general locality as the specimens of *R. laurae*, this specimen apparently represents a different species.

Reticulitermes sp.

Specimen 547 on Nodule 4802 is too small for specific definition. It consists of a part of the cubital system with five parallel veins, the first of which is forked near its base. A similar character occurs in *R. creedei* Snyder, but, according to pattern, in a different position.

TERMITIDAE. AMITERMITINAE.

Gnathamitermes magnoculus rousei, new subspecies (Figs. 5, 9).

Holotype: Specimen 362 (L.A. Mus. Inv. Paleon. Type No. S 9096), on nodule 4067, collected by Mrs. Laura Rouse.

Gnathamitermes magnoculus Light 1932, from Calexico, California has been synonymized by Snyder with *G. perplexus* Banks 1920 of Victoria, Texas, but the venation of the wings of the two species is entirely different, and I am inclined to restore it to specific rank. Its forewing measures about 8.40 mm.

The fossil print fits the pattern of *G. magnoculus* by having the first forking of Media opposite the branching of the 8th or last Cubital; whereas *G. perplexus* has the Medial branch far beyond the last Cubital branch.

Description: The length of the fossil specimen is 6.5 mm., and an extension in the pattern of *G. magnoculus* would give a probable total length of 8.8 mm. The basal Costa-Subcosta-Radius and the Radius$_{4}+_{5}$ run parallel to the apex. Media is closer to Cubitus than to Radius$_{4}+_{5}$, and two branches are evident. Beyond this we assume that there were probably three branches. The first Medial branch is directly opposite the last Cubital branch. Cubitus terminates at distal third of wing and has 8 complete branches as in *magnoculus;* differs from the living form in that between the 5th and 6th there is apparently an abortive branch. There are faint lines between Media and Radius$_{4}+_{5}$.

The wing in this genus differs from that of *Reticulitermes* by having the Media branched; and by having Cubitus terminate at a distance before the apex.

The presence of a tube-forming termite in this area suggests, according to Light (1932. Contribution toward a Revision of the American species of Amitermes Silvestri, Univ. Calif. Publ. in Entom. 5(17):355-414, plates 9, 10, 10 figs.), that moisture and temperature were practically constant at a depth of 48 inches, with the air saturated and maximum temperature of 76° F., when maximum temperature is up to 101°F. In May the tubes of the living termites have a saturated moisture content in early morning when the termites are in the tubes. As the moisture content decreases during the day the termites retreat into the ground. They build earthen tubes around plants, and feed on the outer tissues. This species swarms in August and September after heavy showers.

Of the four genera represented on the Miocene nodules, *Reticulitermes* and *Gnathamitermes* are still present in the desert areas of California; *Cryptotermes* does not now occur west of Louisiana; and is generally tropical; *Parastylotermes* is only known from the Miocene.

LIST OF NORTH AMERICAN FOSSIL TERMITES.

Kalotermitidae. Electrotermitinae.

1. *Prokalotermes hageni* (Scudder) (*Paratermes h.* Scudder)
   1890. Tertiary Insects of N. Amer., U.S. Geol. Surv. Terr., vol. 13, p. 110, pl. 12. fig. 2; alate; Miocene; Florissant, Colorado.

Kalotermitidae. Kalotermitinae.

2. *Kalotermes* sp.
   1946. Lance. Bull. So. Cal. Acad. Sci., vol. 45 (1):21-27; pellets; Pleistocene asphalt; Carpinteria, California.
3. *Cryptotermes ryshkoffi* Pierce
   1958. This article; wing impression; Miocene; Calico Mts., Calif.

Hodotermitidae. Termopsinae.

4. *Zootermopsis* (?) *coloradensis* (Scudder) (*Hodotermes c.* Scudder)
   1883. Proc. Amer. Ac. Arts & Sci., vol 19 (n.s. Vol. 2), pt. 1, p. 142.
   1890. Tert. Ins. l. c. 113, pl. 12, fig. 6; alate; Upper Miocene; Florissant, Colorado.
5. *Zootermopsis* sp.
   1946. Lance. l. c; pellets; Pleistocene asphalt; Carpinteria, California.

Rhinotermitidae. Stylotermitinae.

6. *Parastylotermes washingtonensis* (Snyder 1931) (*Stylotermes w.* Snyder)
   1931. Ann. Ent. Soc. Amer. vol. 24(2):317, pl. 1, fig. 5; wing; Miocene Latah formation; near Spokane, Washington.
7. *Parastylotermes calico* Pierce
   1958. This article; wing impression; Miocene nodule; Calico Mts., California.

Rhinotermitidae. Heterotermitinae.

8. *Reticulitermes fossarum* (Scudder) (*Eutermes f.* Scudder)
   1883. l. c. p. 143.
   1890. l. c. p. 115, pl. 12, fig. 20.
   (Eutermes meadi Scudder 1883. l. c., p. 144; 1890, l. c. pl. 12, fig. 12, 17); alates; Upper Miocene; Florissant, Colorado.

9. *Reticulitermes creedei* Snyder.
   1938. Psyche, vol. 45 (3):109-110, pl. 13, fig. 3; wing; Miocene; Creede, Colorado.

10. *Reticulitermes laurae* Pierce.
    1958. This article; wing impression; Miocene nodule; Calico Mts., California.

11. *Reticulitermes tibialis dubitans* Pierce
    1958. This article; wing impression; Miocene nodule; Calico Mts., California.

Termitidae. Amitermitinae.

12. *Gnathamitermes magnoculus rousei* Pierce.
    1958. This article; wing impression; Miocene nodule; Calico Mts., California.

Mastotermitidae

13. *Blattotermes wheeleri* (Collins 1925) Riek 1952 (Mastotermes), Eocene of Tennessee.
    Collins, R. L., 1925. Amer. Journ. Sci. 9(5):406-410.
    Riek, E. F., 1952. Univ. Queensland Papers, Dept. Geol. 4 n.s. (2): 18, 19, fig. 2.

ORBICULAR GABBRO NEAR PINE VALLEY, CALIFORNIA

By Richard Merriam

ABSTRACT. An orbicular phase of the San Marcos gabbro occurs near the contact with Triassic (?) schist. Orbicules average several inches in diameter, have distinct radial structure and numerous concentric zones. Most orbicules have gabbroic cores, others lack nuclei and some surround schist fragments. Orbicule formation appears to be aided by (1) abundant mineralizers, (2) fluctuations of magma temperature and (3) presence of xenoliths.

INTRODUCTION

Two closely spaced exposures of orbicular gabbro lie in the southwestern corner of the Cuyapaipe quadrangle near the Sheephead truck trail approximately four miles southeast of Pine Valley, San Diego County, California. Plate 8 gives the location and Plate 9 the geologic relationships.

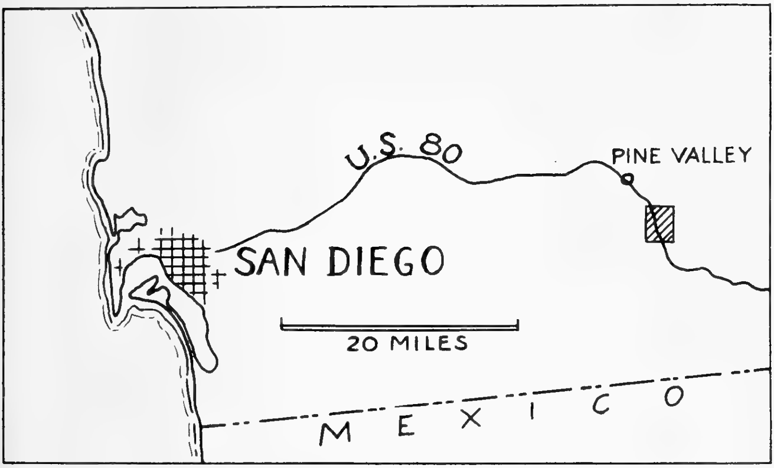

PLATE 8

Map showing location of orbicular gabbro.
Enlargement of shaded area shown in Plate 9.

The orbicular rocks are more or less limited to the contact between gabbro and metamorphic rocks. The former is the oldest member of the early upper Cretaceous Peninsular Range batholith and is generally termed San Marcos gabbro although the names Viejas gabbrodiorite and Cuyamaca basic intrusive have also been used. The gabbro is predominantly a medium-grained, massive, greenish-gray to black rock composed of bytownite or labradorite, hornblende, augite with or without hypersthene and olivine. In the vicinity of the orbicular phase there is a distinct increase in grain-size with the local development of portions approaching gabbro pegmatite. Since hornblende is the principal dark mineral the rock is classified as hornblende gabbro.

The metamorphic rocks are of questionable Triassic age and are locally referred to the Julian schist which is the probable equivalent to Larsen's (1948) Bedford Canyon formation. Lithologically they are laminated gray quartzite, massive banded quartzite and quartz-mica schist. They tend to fracture along joint systems to give angular blocks, plates and chips.

The contact between these formations is obscured by vegetation and overburden so that its position can be only estimated, but it appears to be very near the northern exposure of orbicular rocks and a few hundred feet west of the southern outcrops.

Other rocks of the area are the Green Valley tonalite, Bonsall tonalite and Woodson Mountain granodiorite all of which are post-gabbro members of the batholith.

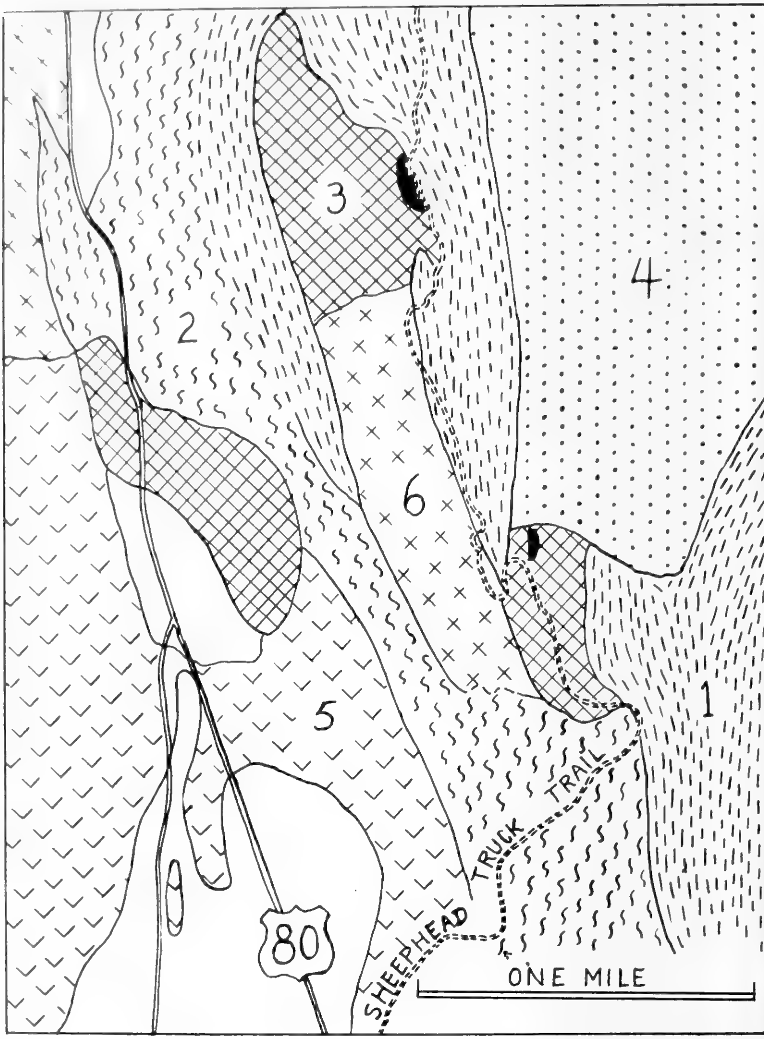

PLATE 9

Geologic map of orbicular gabbro area.
1.—Julian schist, 2.—gneiss, 3.—San Marcos gabbro (orbicular areas black), 4.—Green Valley tonalite, 5.—Bonsall tonalite, 6.—Woodson Mt. granodiorite.

DESCRIPTION OF THE ORBICULAR ROCKS

Exposures of the orbicular gabbro are similar to those of other batholithic rocks of the area which occur as scattered residual boulders more or less in place. The orbicules are best seen on weathered surfaces of the boulders. In places they have weathered out of the matrix and resemble loose cobbles.

The major dimension of the smallest orbicules is somewhat less than two inches whereas the largest reach 10 to 15 inches in diameter. The smallest bodies may be spherical or sub-spherical but the larger ones are elliptical in section or irregular. Some large ones have the shape of angular blocks with rounded corners and edges. Many closely-spaced medium-sized bodies have shapes resulting from mutual interference and are more or less moulded against one another.

The distribution of orbicules as seen in the scattered outcrops is fairly uniform. They are principally slightly separated from one another by interstitial gabbroic material of medium to coarse texture. Only rarely is a single orbicule isolated several feet from all others. More common is the other extreme with a crowding together of many orbicules.

The internal make-up of the orbicules varies widely although all are characterized by concentric zones. In general there are three types: (1) those with nuclei of metamorphic rock (accidental xenolith) surrounded by several concentric shells, (2) those with gabrroic nuclei and numerous shells, (3) simple orbicules with but two or three shells and no apparent nuclei.

Those of the first group are large, rarely less than eight or ten inches across, irregular in shape and comparatively fine-grained. The xenolithic core often retains its original banding and in many cases is essentially the same as the corresponding metamorphic rock. As many as six or eight alternating light and dark shells surround the xenolith.

The many-zoned second type (lacking foreign xenoliths) are the most common. Alternating zones of light and dark minerals vary in thickness from one mm. to two cm. and range to at least eight or ten in number. Grain-size varies roughly as the shell thickness. Some thin zones may consist of 0.5 to 1 mm. grains while adjacent zones are composed of one to two cm. radiating crystals. The cores of this type of orbicule consist of a medium-grained aggregate of gabbro minerals and closely resemble the matrix material in the hand specimen. Orbicules of this group are generally intermediate in size and may show signs of plastic deformation.

Orbicules of the third type (with two or three shells) are usually less than four inches in diameter. Individual zones are thick and are principally plagioclase although some are almost entirely hornblende.

Associated with the orbicular gabbro is a considerable amount of float and occasional outcrops of strongly banded gabbro. Bands, which are straight, curved or wavy, are one to three cm. thick. Crystals composing the bands lie nearly normal to the banding and consist of hornblende in the dark bands and plagioclase in the light bands.

PETROGRAPHY

The matrix enclosing the orbicules is massive hornblende gabbro which varies in texture from medium-to very coarse-grained. Resorbed, altered and replaced minerals are common. Plagioclase (An 60-65) which is the chief constituent amounts to more than 50 percent. Hornblende comprises at least 30 percent of the matrix. Its pleochroic colors are: X–pale yellow, Y–light reddish-brown, Z–reddish-brown. Although some hornblende appears to be of primary crystallization many grains partially replace augite which remains as ragged remants. Some is a pale green, fibrous, actinolitic variety occurring as clots and veinlets and may be of late hydrothermal origin. Chlorite is similar in its occurrence. Hypersthene is rare and entirely lacking in many specimens, and biotite, although present is equally scarce. A few grains of quartz were seen in some slides.

Under the microscope the individual shells of the orbicules are less distinct than in the hand specimen. The concentric, shell-like structure appears to be due partly to an alteration of thick and thin shells. The former in most instances are dominated by sub-radial rods and wedges of plagio-clase having a somewhat feathery appearance. Individual crystals of this mineral traverse the entire width of a shell and stop more or less at a thinner shell. In some thick shells hornblende is the principal mineral.

The thin zones are finer-grained, generally more feldspathic and show little radial orientation of the component minerals. Along contacts between orbicules and matrix and between core and outer shells a tangential arrangement of crystal is typical. This probably is responsible for the manner in which some orbicules break cleanly from the matrix like cobbles from a weakly cemented conglomerate. An additional factor in distinguishing separate shells is the ratio of ferro-magnesian minerals to feldspar, which varies from zone to zone.

PLATE 10

Examples of orbicular gabbro. Scale is six inches long.

PLATE 11

Example of orbicular gabbro. Scale is six inches long.

The plagioclase averages approximately An 66 in composition and forms more than half of most orbicules. Its wedges and rods, elongated parallel to the a axis, range to one or two cm. in length. The mineral is consistently fresh but carries many inclusions.

Whereas hornblende is the predominant dark mineral of the matrix, hypersthene is much the more abundant in the orbicules, averaging 30 percent. It occurs as irregular one-to four-mm. grains elongated roughly parallel to the c axis. These lie between, and moulded against, the plagioclases and occur as granules in the thinner zones.

Augite is a much less common pyroxene and occurs as scattered anhedral grains rarely exceeding 0.5 mm. across. Hornblende, except where it is the principal mineral of a wide zone, is about as common as augite. It has the same pleochroic colors as that in the matrix. Biotite is sometimes present but is the most uncommon ferromagnesian mineral. There are the usual minor accessories such as zircon, apatite and magnetite.

The gabbroic cores of the orbicules have approximately the same mineral composition as the average of the enclosing shells. However the cores differ in texture from both shells and matrix. In many it is panidiomorphic granular with grain size of 0.5 to 1 mm. Some approach the mosaic texture characteristic of certain phases of the San Marcos gabbro. Others are medium to coarse hypautomorphic granular. Euhedral to subhedral crystals of plagioclase (An 65) account for 50 percent of the core. Hypersthene (25 percent) is often partly replaced by hornblende, as is augite which is a less common mineral. The hornblende is reddish-brown as in the shells and matrix, and averages 15 percent. Reddish-brown biotite is widespread but not abundant. Chlorite veinlets and clots are common.

ORIGIN

The precise mode or origin of such rocks has not been determined satisfactorily although two other occurrences of similar nature in nearby areas, and one in Baja California have been published.

Lawson (1904) described orbicular gabbro from Dehesa approximately 20 miles west of Pine Valley. The outcrops of this gabbro, which were small, have since been almost entirely removed. According to Lawson's description the average orbicule diameter was one or two inches. They were composed of concentric shells of plagioclase and olivine. The essential minerals of the enclosing rock were plagioclase and hornblende with subordinate amounts of olivine and hypersthene. No cores of foreign material were noted. The concentric shells were explained as the result of a fluctuation of temperature during crystallization. A "radial movement of diffusion currents" was considered a possible cause of the radial structure.

F. S. Miller (1938) mentioned nodular structure near Vista Grande and orbicular structure near Pala, both in the San Luis Rey quadrangle (1: 125000), San Diego County. The nodules are imperfect, rough, and lack concentric zones. The orbicules, first described by Schaller (1911), have cores of ordinary olivine norite surrounded by radiating plagioclase, hypersthene and olivine. There are no concentric shells. No conclusions as to origin were reached but the probable abundance of irregularly

distributed mineralizers in the gabbro magma was pointed out by Miller. No reference was made to schist or any other rocks contaminating the gabbro.

An occurrence of orbicules in gabbro of the Peninsular Range batholith in the San Pedro Martir, Baja California was noted by Woodford and Harriss (1948). It lies near a contact; nuclei are present but not "foreign bodies", and some orbicules are flattened. No explanation of origin was offered.

In his exhaustive report on orbicular rocks Sederholm (1928) pointed out that in many cases concentric crystallization has occurred around zenoliths and most if not all orbicules result from reaction of a magma with xenoliths. This generalization appears to apply to the rocks here described. Those lacking xenolithic cores may be assumed to have resulted from complete digestion of the xenolith due to its small size or susceptible composition. Orbicules with gabbro-like cores are more difficult to explain. Possibly cooling near the schist-gabbro contact produced a gabbroic margin which was later brecciated by magmatic or other movements, thus contributing fragments which were engulfed in the still-liquid portion of the magma to form nuclei for orbicules.

The cause of alternating crystallization of light and dark minerals, as well as of thick and thin zones is not apparent, and evidence furnished by this occurrence seems to eliminate any simple explanation. There is not a complete correspondence among the zones of all orbicules, although those of a single exposure generally show about the same sequence. Thus the physical-chemical conditions, and fluctuations thereof, varied from place to place. Variations in amount and composition of mineralizers would seem more easily accomplished than temperature variations although both are possibilities. There may have been rhythmic, pulsatory influxes of mineralizers or mineralizer-rich magma along certain zones. Some differences in shell sequence may have resulted from differences in original nuclei.

Large crystals of hornblende and plagioclase in the orbicules as well as the coarse-textured matrix indicate abundant mineralizers. The relative abundance of hornblende and chlorite in the matrix also suggests this, while associated coarse-textured

banded gabbro must have required a more than average amount of mineralizers.

A special, rare set of conditions must be required as evidenced by the widespread occurrence of unzoned xenoliths in most intrusives. Possibly the following factors are important: (1) abundant mineralizers irregularly distributed in space and time, (2) available xenoliths, (3) temperature fluctuations of a magma in a critical stage.

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THE OVA AND FIRST LARVAL INSTARS OF THREE SOUTHWESTERN MOTHS

By John Adams Comstock

It occurs not infrequently, when working with life histories of lepidoptera, that eggs are secured from gravid females, which hatch, but for which it is impossible to obtain food plant that is acceptable to the young larvae.

While this results in only fragmentary notes, it never-the-less makes possible the recording of the egg, and first larval instar, which is probably the most important phase of any given life history.

Notes of this incomplete character are herein presented for two species of rare phalaenid moths from Arizona, and one from southern California.

Pleroma cinerea Smith

A large number of eggs of this species were received early in January of 1957 from my valued correspondent, Noel McFarland. They were secured from a gravid female taken in the Beverly Hills area.

PLATE 12

Egg of *Pleroma cinerea* Smith
Enlarged approximately 48 diameters.
Reproduced from painting by the author.

The eggs hatched on January 6 and 7, 1957. It was noted that the larvae obtained egress by eating a hole through the side of the egg, rather than the micropylar end. The remaining part of the shell was not consumed.

Ovum: Conoid, the base flat and the top gently rounded, with a small, well depressed micropyle in the center. Size, .75 to .80 mm. wide at base, by .77 to .84 mm. tall.

The surface is covered by narrow vertical ridges which start at the base and converge on the margin of the micropyle. There are from 24 to 28 of these ridges, but a number of them end or join with others as the top of the egg is approached. The ridges are studded with small nodules along their free edges. The troughs or depressions between them are crossed horizontally by fine grills. The micropyle is granular.

The ground color of the egg is gray-green, on which numerous black blotches of varying sizes and shapes are superimposed. In some examples these blotches tend to encircle the egg horizontally, in one or more circlets, but the pattern is irregular and varies with each egg.

The egg is ilustrated on Plate 12.

Larva, First Instar: Length, 3.5 to 4 mm.

Head. Width, approximately .5 mm. which is considerably wider than the first body segment. The surface is a glistening and slightly translucent light gray, sprinkled with black and brown blotches. The mouth parts are edged with black, and the ocelli are black. A few short setae occur on the face, each arising from a small black papillus.

Body. The scutellum consists of two large triangulate raised dark elements, one on each side of a light gray middorsal line. The bases of the triangles rest on the cephalic margin of the first segment.

There is a broken middorsal light gray longitudinal stripe or band. The remainder of the body is a dull slaty gray.

Numerous black setae occur on the body, each arising from a black papillus.

True legs, gray, with black segmental margins. Prolegs, (four pair), the caudal two pairs larger and functional, the others, small and non-functional. All are concolorous with the body.

The tenth segment is slightly elevated dorsally.

S. E. Crumb, in his "Larvae of the Phalaenidae", pp. 67-68, 1958 gives a description of the "basic pattern" of a mature larva of the genus, and lists the food plant as *Symphoricarpus* (Snowberry). As the latter plant was not available, the young larvae were offered three varieties of honeysuckle, *Ceanothus*, and *Cercocarpus*, all of which they refused.

Miracavera brillians Barnes

On July 4, 1956, while camping in Pinery Canyon, Chiricahua Mountains, Cochise County, Arizona, at an elevation of 7200 ft., a gravid female of this beautiful noctuid came to light, and obligingly laid a number of eggs on the third day after capture.

The eggs were laid in compact clusters, a single layer deep. Several separate clusters were deposited on the surface of a piece of rough paper that had been placed in the rearing cage.

OVUM: Approximately 1 mm. wide by .65 mm. high; hemispherical, the base flat. The surface bears approximately 20 narrow vertical ridges, topped by minute nodules. These run from base toward the crown, but none of them reaches the edge of the micropyle. Some terminate near the top, and a few become obsolete near the upper third. Between the ridges there are minute horizontal, and barely perceptible lines.

The basic color of the egg is a delicate creamy white. On the majority of examples there is a circlet of red-brown spots, placed at about the juncture of the upper third and the lower two-thirds of the egg. The spots composing this circlet are varied in size and irregular in placement, some being confluent, and others discrete. The circlet may also be broken or restricted, and in a few examples it is entirely absent.

The micropyle is small, and in the majority of specimens is speckled with minute red-brown dots.

The egg is illustrated on Plate 13.

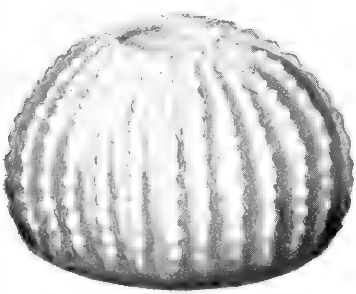

PLATE 13

Egg of *Miracavera brillians* Barnes.
Enlarged approximately 45 diameters.
Reproduced from painting by the author.

Larvae emerged on July 13 and 14, '56. They were offered *Sambucus* (Elderberry), the food plant of the nearest relative, *Feralia februalis* Grote, but showed no interest in it. Several other plants were tried, including pine, oak, willow, aster and *Rhus,* with negative results. By July 16 all had perished, but not before notes were made.

FIRST INSTAR LARVA: Length, 2.2 mm.; subcylindrical.

Head much wider than any body segment; dull orange, the ocelli black, and the mouth parts edged with black.

The body is translucent gray, the middorsal area being silghtly darker. The caudal portion at about the eleventh segment is raised dorsally into a hump.

The last two pair of prolegs are relatively large and functional, and the first two pair are reduced in size, and non-functional.

The middorsal area is bordered laterally with a longitudinal row of black papilliform spots, two to each segment on each side. Stigmatally there occurs a row of much larger black papillae, one to each segment on each side. Inferior thereto is a second row of black papillae. All of the papillae bear short black hairs.

The abdominal surface (venter) is tinged with light yellow.

The legs are translucent gray with darker tips, and the prolegs are concolorous with the body, with black plates superimposed on their lateral surfaces.

PLATE 14

Egg of *Paramiana viridescens* B & McD.
Enlarged approximately 50 diameters.
Reproduced from painting by the author.

Paramiana viridescens Barnes & McDunnough

A single female of this beautiful green-spotted noctuid came to light on the night of July 3, in the same locality as that where the previously discussed species was taken. Eggs were obtained July 4.

Since nothing was known of the life history or habits of this moth, the question of food plant was a problem.

The area of the camp was in a plant association that was dominated by pines, black walnut, white oak, fir and juniper.

Leaves of these plants were placed with the newly hatched larvae, but were not accepted. We were therefore forced to be content with a drawing and description of the egg, and a brief note on the larva.

Ovum: Size, .8 mm. wide by .6 mm. high. In form, it is subspherical, with a flattened base and well rounded top.

The surface is crossed vertically by about 26 nodular ridges, running from base to micropyle, about 12 of which make contact with the micropylar margin.

The micropyle is relatively large, and is not deeply depressed.

The color of the egg is light yellow. See Plate 14.

Larva, First Instar: Eight examples of the eggs hatched on July 14, 1956. At that particular time we were so fully occupied with numerous colonies of hungry larvae, each requiring special food, that we were unable to make measurements, or transcribe detailed notes.

The newly emerged larva had a large translucent yellow head, with black ocelli, and a translucent yellow body bearing a number of light yellow hairs. By the time we were ready to amplify this information, all of the babies had perished.

A RESAMPLING OF WOOD RAT HOUSES AND HUMAN HABITATIONS IN GRIFFITH PARK, LOS ANGELES, FOR *Triatoma protracta* AND *Trypanosoma cruzi*

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INTRODUCTION

Continued reports of western conenose bug annoyances by verbal communications and special interest in rate of appearance of *Triatoma protracta* (Uhler) in dwellings occupied by man, prompted the senior author during the summer of 1957 to check thoroughly the Boy's and Girl's Camp areas in Griffith Park, Los Angeles County, California, for the presence of these blood feeding insects.

Of the 401 *Triatoma protracta* reported here, 304 were collected at the Boy's Camp and immediate vicinity (Areas 29 and 30), 91 from the Girl's Camp (Area 65), 1 from the Zoo (Area 24) and 5 from a residence near Area 60. The first adult *Triatoma* found in human habitations during 1957 was taken at the Boy's Camp on July 2nd and the last at the Girl's Camp on September 28th with the heaviest invasions occurring during July and August. Two hundred thirty-four conenose bugs were taken in human habitations, 142 from wood rat houses, 17 in pool and bath house, 7 from the camp grounds area, and 1 from a Zoo animal cage. Ninety-two, or 24%, of the 383 bugs examined were found to harbor *Trypanosoma cruzi* Chagas.

MATERIALS AND METHODS

Area reference designations follow the September, 1955, revised Fire Map of Griffith Park from the Department of Recreation and Parks, City of Los Angeles.

Specimens of *Triatoma* were collected from buildings, camp grounds, residences and wood rat houses. The bugs were fed in the laboratory on trypanosome-free white rats or mice and the droppings or dissected gut contents were examined microscopically for *Trypanosoma cruzi* previously demonstrated in the area in bugs by Wood (1953b) and in the wood rat by Wood and Hughes (1953).

[1]The writers thank Ann C. Woolf, Girl's Camp Director, Melvin C. Carlson, Boy's Camp Director, Arthur L. Gladwill, Caretaker, and the camp counselors for voluntary collecting of *Triatoma*. The writers appreciate the permits issued by the Los Angeles City Department of Recreation and Parks on recommendation of the City Health Department and the availability of laboratory facilities in the Division of Natural Science, Los Angeles State College and the Life Science Department, Los Angeles City College, which made possible this study on the City College Campus.

Naturally infected conenose bugs, *Triatoma protracta,* were used to infect Wistar white rats for demonstration of developmental stages of *Trypanosoma cruzi* in the mammal host. Tissue touch preparations of fresh excised muscle were heat fixed and stained with Jenner-Giemsa blood stain (Wood, 1953a).

OBSERVATIONS

Two hundred forty bugs were collected in the Boy's Camp area as summarized in Tables I and II during 1956-57. One hundred fifty-five were taken in buildings, 78 from wood rat houses and 7 from the camp grounds. Eighty-nine, or 37%, were found to harbor *Trypanosoma cruzi.*

The cabin area of the Boy's Camp occupies 3 acres at the head of a small canyon running in a west-east direction. The frame camp buildings are distributed mostly in a west-east axis between the 700 and 800 foot level. They occupy a chaparral wooded southeast facing slope which extends upwards to the north and west to 1100 and 1200 feet above sea level. Because the wood rat houses are mostly above 800 feet behind the camp area, the site affords an easy down canyon flight pattern to man for blood meals. The prevailing westerly winds also facilitate this flight line. Wood rat houses were found 100 yards northwest of the cabin area center and the same distance northeast of the lodge building.

Bugs were collected in the buildings on walls, ceilings, screens, and floors, in pantries, sinks, closets, desk drawers, shoes and folds of blankets, on clothing, under pillows, mattresses or sleeping bags, and in a few instances were found crawling on the campers in the morning. Three bugs collected from campers or their beds were found engorged with blood indicating possible recent feeding on man. Of 6 bugs found in camper's luggage, 3 were infected with trypanosomes. Conenose bugs were taken from 24 different sources at the Boy's Camp as indicated in Table I. Fifty-three bugs were collected in July, 103 in August and 6 in September.

Of 16 wood rat houses searched in the Boy's Camp area, 7 contained *Triatoma protracta* as shown in Table II. In all but one wood rat house, bugs were found naturally infected with *Trypano-*

soma cruzi. Wood rat houses 1, 2, 4, and 5 were in Area 30, the rest in Area 29.

TABLE I

1957 Summer Conenose Bug Collection from Griffith Park Youth Camps

SOURCE	Boy's Camp		Girl's Camp		Number Infected with
	Triatoma protracta				*Tryp. cruzi*
	Coll.	Exam.	Coll.	Exam.	
Director's Home	1♂, 6♀	7	22♂, 15♀	30	2♀
Caretaker's Home	7♂, 8♀	15			2♂, 4♀
Lodge Building					
Office	11♂, 22♀	33	2♂, 3♀	5	5♂, 4♀
Kitchen	2♂, 7♀	9	1♂, 4♀	5	3♀
Cook's Quarters	3♂, 10♀	13			1♂, 5♀
Dining Hall	3♂, 13♀	16			3♂, 6♀
First Aid Room	4♀	4	3♀	3	3♀
Women's Rest Room	1♂, 1♀	2			
Cabin #1	3♀	3	2♀	2	1♀
Cabin #2	2♂, 8♀	10			1♂, 3♀
Cabin #3	1♀	1	2♀	2	1♀
Cabin #4	1♂, 4♀	5			1♂, 2♀
Cabin #5	1♂, 4♀	5			2♀
Cabin #6	1♂, 1♀	2			1♂
Cabin #7	6♂, 5♀	11			4♂, 3♀
Cabin #8	1♀	1	3♀	3	1♀
Cabin #9	1♂, 1♀	2			1♂, 1♀
Cabin #10	2♂, 2♀	4			
Cabin #11	1♂	1	2♂, 2♀	4	
Cabin #12	1♂, 7♀	8			1♂, 1♀
Cabin #15	1♂	1			
Camp Grounds	3♂, 4♀	7			1♂
Rest Room #1	1♂	1	1♀	1	
Swimming Pool			8♂, 8♀	5	
Pool Bath House	1♀	1			
Totals:	49♂, 113♀	162	35♂, 43♀	60	21♂, 42♀

NOTE:

All bugs from the Girl's Camp were negative for trypanosomes.

TABLE II

1956-57 Wood Rat House Survey in Griffith Park
Areas 29 & 30, Los Angeles

WOOD RAT HOUSE	NO. OF BUGS	CONENOSE BUGS, Triatoma, EXAMINED Adults	Nymphal Instars 5th	4th	3rd	2nd	NUMBER INFECTED WITH Tryp. cruzi
#1	10	2♂, 4♀	1			3	1♂ 4♀
#2	7	3♂, 1♀	3				2♂, 1♀, 1-5th
#3	23	1♂	12	4	5	1	2-5th
#4	4	3♂	1				
#5	20	8♂, 5♀	3	2	2		5♂, 5♀, 2-5th
#6	5	1♂	2	1	1		1♂
#7	9	3♂, 2♀		3	1		2♀
Totals:	78	21♂, 12♀	22	10	9	4	9♂, 12♀, 5-5th

Seventy-eight conenose bugs were collected from buildings and grounds of the Girl's Camp as indicated in Table I. The 16 bugs taken from the pool deck, gutters and water were found after dark between 8:45 and 9:15 PM on 31-VII-57 when the nearby hillside was sprayed with Dieldrin. All bugs examined were negative for trypanosomes from the 10 different sources in the Girl's Camp area as indicated in Table I. Twenty-six were taken in July, 41 in August and 11 in September.

The senior author checked Area 24 for bugs due to the presence of wood rat houses and verbal reports of bug occurrences in animal quarters at the Zoo. In the *Felis jaguarondi* cage, Clark Ward found one live male *Triatoma protracta* which upon microscopic examination revealed actively motile *Trypanosoma cruzi.*

Near Area 60, 1 male and 4 female *Triatoma* were found in a home bordering the Park by Ruth S. Stein. All were negative for trypanosomes. One bug was collected on July 18th, 3 on the 2nd, 7th and 24th of August, and 1 on September 13th.

The junior author sampled 3 wood rat houses in the Boy's Camp Area 30 near the lodge building and stables on 29-XII-52 from which 6 and 58 *Triatoma* were found in 2 houses. All these bugs were negative for trypanosomes. On 16-VII-53, 13 *Triatoma protracta* were received at Los Angeles City College from the Girl's Camp, 10 from the Director's Home, 2 from the Lodge Craft Room and 1 from the swimming pool. All were examined for trypanosomes and 1 male found floating in the pool and 1 female

from the Director's Home contained living *Trypanosoma cruzi* in contrast to the negative results reported above.

In order to check the specific identity of the trypanosome, the junior author inoculated 4 day old Wistar white rats with 0.05 ml of a 0.3 ml suspension in sodium citrate solution of the rectal contents of 2 naturally infected female *Triatoma protracta* from wood rat house #7 (Table II), Area 29, Griffith Park. Six days after intramuscular inoculation into the left gastrocnemius, two white rats were sacrificed for tissue touch preparations of the fresh muscle. In one rat, 9 slides were prepared from gross-sectioned bits of excised muscle in contact with their surfaces. Eight slides were heated by placing them approximately 5 inches beneath a desk lamp with half-globular reflector and 60 Watt Hygrade blue bulb, then removed and touched with the freshly cut muscle surface while slide #9 was used for tissue deposit at room temperature. All slides were negative for developmental forms of *Trypanosoma cruzi* except numbers 5, 206 sq. mm, 6, 210 sq. mm, and 9, 375 sq. mm, on which 7 leishmaniform parasites were found characteristic of the tissue developmental forms demonstrated by Wood (1953a). Both regressive, with volutin granules and basophilia, and progressive leishmaniform parasites were found. Total area surveyed on the 9 slides covered about 2,386 square millimeters.

The second rat failed to show developmental forms from survey of 7 tissue touch and 1 tissue deposit slides covering about 2,243 square millimeters, collectively.

One 4 day old white rat inoculated subcutaneously in the belly area at the same time revealed to Dr. Fae D. Wood 2 blood forms of *Trypanosoma cruzi* in a fresh sample and 1 stained specimen on an air dried smear on the 13th day after inoculation when sacrificed for tissue sections. Another rat inoculated intramuscularly into the right gastrocnemius remained negative for trypanosomes.

DISCUSSION

The junior author estimated a potential bug population of 1500 for Areas 29 and 30 in 1950 after counting the wood rat houses in the immediate vicinity of the Boy's Camp and sampling

the *Triatoma* in the wood rat houses (Wood, 1953b). Only a small proportion of the potential bug source could be expected to appear in habitations of man because the adult bugs do not all leave the wood rat houses due to their poor flying ability (Wood, 1949, 1951), the wood rats are efficient in satisfying their blood meal needs (Wood, 1947), the total number of flying forms, or adult winged males and females, is much smaller than the total bug population per wood rat house, and *Triatoma protracta* has a low hunger drive for man (Wood, 1951). Some idea of this expected annoyance for a reasonably limited area is recorded here for the Boy's Camp where ecological conditions have not changed markedly since 1950. The 1950 wood rat den sample revealed 33.9% adults (Wood, 1953b), and the 1956-57 sample reported here revealed 73.3% adult *Triatoma*. Assuming a 53% adult population for the summer of 1957 and a 25% developmental mortality loss plus a 10% predator loss since the wood rat, *Neotoma*, and white footed mice, *Peromyscus*, eat *Triatoma* (Wood, 1952), then our expected adult population of conenose bugs leaving the wood rat houses in the Boy's Camp area to satisfy their hunger drive might be 225 adults as compared with the 162 reported here in Table I.

However, little is known of the population pressure factors for *Triatoma* in wood rat houses, and conditions vary markedly from year to year as to maintenance of potential mammal hosts, yet in the region studied, more mammal food is available continuously. The physiographic features of the area favors the down canyon flight pattern of *Triatoma* to occupied human dwellings observed frequently in the southwest (Wood, 1949).

Wood (1953b) found a general infection rate of 17.4% from examination of mostly field collected bugs whereas 29.4% is reported here for mostly home invading bugs. A comparison of Table II of Wood (1953b) with Table II here shows a 40% infection rate with 2 of 7 wood rat houses negative as compared with a 33.3% rate with 1 of 7 houses negative, revealing that essentially the same conditions exist for recovery of *Triatoma* naturally infected with *Trypanosoma cruzi* in the identical location near the Boy's Camp. The 1956-57 survey reports here 21 adult and 5 nymphal bugs naturally infected with trypanosomes in contrast to 17 adults and 13 nymphs for 1950.

The discovery of naturally infected conenose bugs in camper's luggage suggests possible dissemination of infected bugs to Los Angeles homes.

The unusually large number of bugs at the Girl's Camp Director's home shown in Table I would indicate that the site is in a natural flight path of these blood sucking insects in that area, or the insects are attracted to food animals as pet dogs or cats, or that breeding of *Triatoma* is occurring in a rodent harborage under the house and the adult bugs invade the living quarters of man.

The largest number of adult *Triatoma* collected here at one time was the 16 bugs taken from the Girl's Camp pool after dark in the early evening of July 31, 1957. The use of dieldrin on buildings and nearby vegetation during the daytime may have stimulated the movement of these bugs as well as slowed them down as observed previously for DDT by Wood (1951).

The presence of mammals from Mexico, Central and South America in our American Zoos near sources of native blood sucking bugs offers the possibility of local insects picking up imported mammal trypanosomes and transmission of local trypanosomes to imported animals. The original California source of naturally infected *Triatoma* in San Diego County, California is not far from the San Diego Zoo.

It is interesting to note that the Griffith Park area is continuing to produce *Triatoma* naturally infected with *Trypanosoma cruzi* which are able to come into contact with man at varying intervals despite collecting of bugs and trapping of mammals by many individuals. The number of human contacts with *Triatoma* should be increasing constantly due to increased use of the area by man but this type of study should help in controlling the annoyance by reducing the bug population in the region. Control of the wood rats, destruction of wood rat dens and rodent harborages, and protective insecticidal spraying should eventually cut down the bug population and reduce the contacts and annoyance to man. At present, the use of insecticidal sprays is of definite value in weakening *Triatoma protracta* and controlling its feeding drive on man as noted previously by Wood (1951).

In view of the recent demonstration of the first human case of Chagas' Disease in Texas (Woody and Woody, 1955) from

Corpus Christi where incidences of bug infections with *Trypanosoma cruzi* are no higher than here, critical notice of symptoms of persons reporting contacts with *Triatoma* should be screened carefully for possible trypanosome infections especially when noted in infants.

SUMMARY

Of 401 *Triatoma protracta* collected in Griffith Park, Los Angeles, California, mostly in 1957, 383 were examined for trypanosomes. Ninety-two, or 24%, were infected with *Trypanosoma cruzi.* Verification of the identity of the trypanosome was established by demonstration of leishmaniform parasites in muscle of experimentally infected white rats from naturally infected *Triatoma.*

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A NEW MICROVELIA FROM VENEZUELA (HEMIPTERA:VELIIDAE)

By CARL J. DRAKE[1] AND JANIS A. ROZE[2]

This paper lists six species of the genus *Microvelia* Westwood (1834) heretofore recorded in the literature from Venezuela. These are *Microvelia pulchella* Westwood (1834), *M. longipes* Uhler (1893), *M. marginata* Uhler (1893), *M. albonotata* Champion (1898), *M. duidana* Drake and Maldonado (1952) and *M. ayacuchana* Drake and Maldonado (1952). The apterous form of the new species described below is unknown.

Microvelia timida, new sp. (Plate 15)

Small, blackish brown with the pronotum in front of humeri and lateral sides of thorax (largely) brownish; connexiva above and beneath brownish testaceous with exterior margin edged with dark fuscous; antennae dark fuscous with basal part of first segment pale testaceous; Legs dark fuscous with coxae, trochanters, basal part of femora above and most of femora beneath pale testaceous. Pronotum a little variable in color, sometimes with the dark fuscous extending anteriorly on median part of disc Head black above, mostly testaceous beneath. Thorax beneath and venter blackish. Rostrum brownish testaceous with apex dark. Length, 1.90 mm.; width. 0.80 mm.

Head 0.40 mm. wide across eyes, moderately convex above, with smooth, median, longitudinal, impressed line and usual basal marks; eyes large, dark fuscous. Antennae long, slender, pubescent with a few, scattered longer hairs, measurements—I, 0.17; II, 0.15 mm.; III, 0.20 mm.; IV, O. 30 mm. Rostrum with apex reaching a little beyond prosternum. Anterior tibia slightly shorter than femur (25:30), provided with a short, cylindrical, spurlike projection which extends obliquely downward on the inferior side of the apex of segment (fig. 1a.) All legs unarmed, clothed with short pubescence. Hind femur 0.56 mm. long, the tibia 0.62 mm. Tarsal segment II of both middle and hind legs a little longer than I.

Abdomen and hemelytra subequal in length, each 1.40 mm. long. Last venter of male deeply broadly excavated behind, with apical margin at bottom of excavation only feebly rounded and without median apical notch; parameres strongly curved with apex narrowed, falciform. Female usually slightly stouter than male, with last abdominal segment a little longer than preceding; color and markings as in male.

HOLOTYPE (male) and ALLOTYPE (female), both alate, Silva Lista, D. F., Venezuela, in Drake Collection (U.S.N.M.). PARA-

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[2]University of Venezuela, Caracas, Venez.

types several alate specimens of both sexes, taken with type, in collections of both authors.

Separated from *M. marginata* Uhler by coloration and antennal measurements. The short, cylindrical, apical projection of the anterior tibia is quite distinctive of this species. The male abdomen beneath is without a tubercle on sixth segment as is found in that sex of *M. mimula* B.-White.

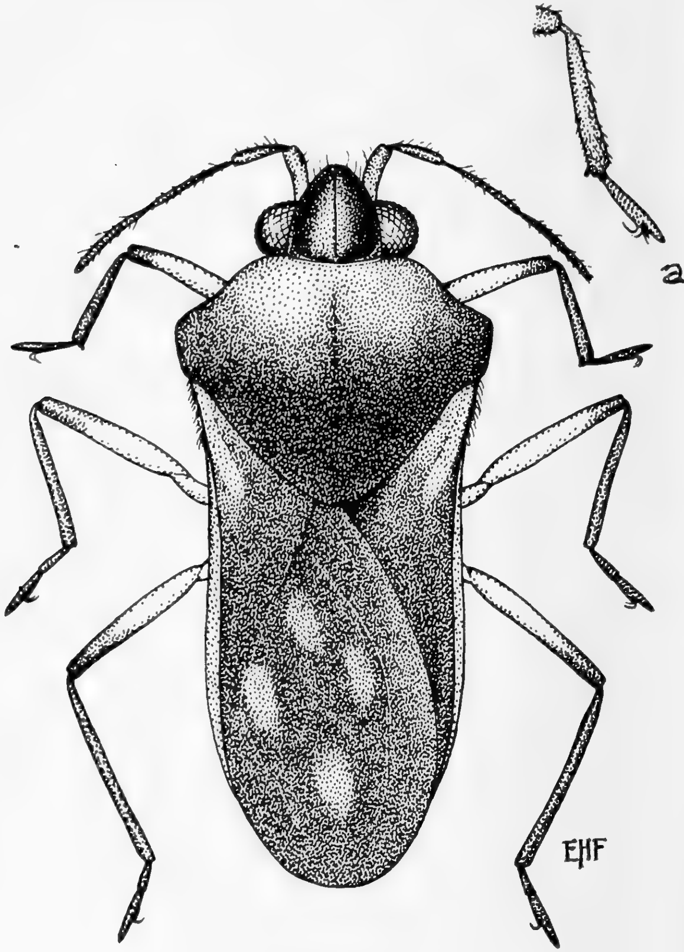

PLATE 15

Microvelia timida, new sp. (male); anterior tibia showing apical projection.

AN ADDITION TO THE KNOWN CERAMBYCID FAUNA OF THE REVILLAGEGEDO ARCHIPELAGO
(Coleoptera)

By E. GORTON LINSLEY
University of California, Berkeley

Through the kindness of Dr. John N. Belkin and Mr. William A. McDonald, Department of Entomology, University of California, Los Angeles, I have had the privilege of examining a small collection of Cerambycidae from Clarion Island, Revillagegedo Archipelago, which were reared from *Sapindus sopolaria* collected on May 7 and 8, 1955. Included were nine specimens of *Nesodes insularis* Linsley, previously reared from *Sophria tomentosa* (Linsley, 1935), and an apparently new species of *Acanthoderes.* This last brings the total for the known species of Cerambycidae for this island group to four.

Acanthoderes peritapnioides Linsley, new species

FEMALE: Form short, robust; integument piceous black, with the antennae, legs, dorsal surface of head, disk of pronotum, an oblique ante-median impression on each elytron, and some of the sterna reddish; surface subglabrous, very finely punctate with scattered coarse punctures, and with irregular dense patches of short, coarse, appressed white hairs at sides of pronotum and in elytral impressions, brushes of white hairs on the tibiae, and scattered short coarse white hairs arising from coarse punctures elsewhere. HEAD finely, densely punctate, a few coarse punctures at middle of face; antennae not attaining elytral apices, surface finely punctate, clothed with fine short appressed pubescence, with scattered, short, somewhat coarse, suberect hairs, scape moderately robust, third segment elongate, segments four to ten gradually decreasing in length, eleventh segment very much shorter than tenth. PRONOTUM transverse, armed at sides with a large conical tubercle, surface very finely punctate, with scattered, superimposed, coarse punctures on disk and toward margins, most numerous on the densely white-pubescent ventro-lateral surface; scutellum finely punctate, glabrous; prosternum shining, finely punctate, punctures denser at sides and on intercoxal process. ELYTRA piceous, with apices and oblique ante-median impressions reddish; surface finely punctate with scattered coarse punctures super-imposed; apices slightly flaring, separately subtruncate. LEGS moderately robust; femora finely punctate, pubescence sparse, fine, obscure, denser toward apex; tibiae finely punctate, densely clothed over apical three-fourths with a dense brush of long erect white hair; tarsi densely and similarly clothed. ABDOMEN finely, densely punctate, thinly clothed with short, obscure pubescence. Length, 11.5 mm.

Holotype female (Calif. Acad. Sci.), reared from *Sapindus sapolaria*, on Clarion Island, Revillagegedo Group, Mexico, May 7, 1955, by William A. McDonald and D. C. Blodgett.

This species may be distinguished readily from *Acanthoderes socorroensis* Linsley (1942), the only other member of the genus known from the Revillagegedo Islands, by the piceous coloration, subglabrous integument, less robust form, flaring and separately truncate elytral apices, and numerous other features. Superficially the species is suggestive of *Peritapnia fabra* Horn.

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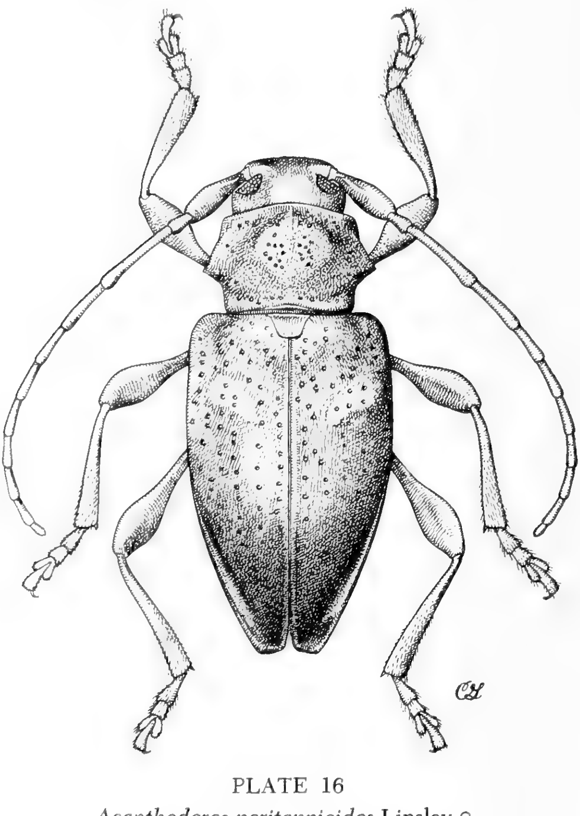

PLATE 16

Acanthoderes peritapnioides Linsley ♀
(Drawing by Celeste Green)

LIFE CYCLE STUDIES OF THE BRACHYURA OF WESTERN NORTH AMERICA, I. GENERAL CULTURE METHODS AND THE LIFE CYCLE OF *LOPHOPANOPEUS LEUCOMANUS LEUCOMANUS* (LOCKINGTON)

By JENS W. KNUDSEN*

INTRODUCTION

Information concerning the larval stages of our Pacific Coast Brachyura and their development is, for the most part, very limited. The larval forms of these animals have consistently appeared in plankton-net hauls and fish gut-contents and yet their identity has remained obscure. Hart (1935) attributes this to the fact that it is usually necessary to rear the larval stages in the laboratory to be at all sure of their identification. Hart succeeded in rearing four west coast species of Brachyura. Since her work, the larval forms (first zoea and/or megalops) of a few species have been identified and briefly described. To the writer's knowledge, however, no other life histories of west coast Brachyura have been studied in the laboratory. The writer has, to date, reared all of the larval stages of five species of Brachyura from California, the first description of which will appear in this paper. Other descriptions will follow as the plates are prepared for publication. The problems encountered in rearing the larvae and the methods used with the greatest success are also presented herein.

Because the over-all picture of brachyura larval taxonomy is far from complete, the writer has chosen to describe and illustrate, as fully as possible, the different larval stages of each species. Much of the early literature dealing with brachyuran larvae has proven to be of little value because of (1) faulty identification, (2) inadequate description of substantial taxonomic characteristics, and/or (3) poor illustrations of gross anatomy and little attention to details of the anatomy. It is imperative, therefore, that ample description and illustration be provided for larvae which are positively identified if the work is to prove of future value.

The work involved in this paper was completed at the Allan Hancock Foundation, University of Southern California, Los Angeles, California. The writer is grateful to Dr. John S. Garth and Dr. Norman T. Mattox for their assistance and guidance in this study.

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CULTURE METHODS

The chief difficulties encountered in the laboratory are: (1) maintaining a sea water supply; (2) transporting crabs to the laboratory; (3) keeping the spawn alive; (4) maintaining clean cultures; (5) controlling temperature; and (6) maintaining a source of food for the larvae.

Sea water can be hauled to the laboratory in five-gallon bottles and stored in a cool, dark room. The water does not need to be filtered before using. Ovigerous females are best transported to the laboratory in large, non-metal containers which require no water, but rather need thick layers of wet seaweed of a non-mucus secreting species such as *Pelvetia fastigiata* (J. C. Agardh) Detoni. The container should be kept as cool as possible during the collecting and transporting of ovigerous females. When it is necessary to transport crabs for periods of time longer than one hour, the animals may be placed in large (12-14 inch) cylinder jars with one or two inches of sea water. The water can be aerated by means of an air breaker attached to a rubber tube, which in turn is attached to a super-inflated inner tube. The valve of the tube should be loosened first to allow a proper flow of air. The inner tube can be refilled at service stations from time to time while enroute. Either method will work satisfactorily but transportation in wet sea weed has proven best for average hauling.

Ovigerous females should be isolated in the laboratory in small aquaria until the time of hatching. It is then necessary to move them to aquaria with a large volume of fresh sea water before the spawning occurs. Unless this is done, the number of newly hatched larvae is sufficient to putrify the water and kill or weaken the spawn. When the larvae hatch they begin swimming and soon fill the aquaria. The stronger larvae may be attracted to a source of light placed high up on one side of the aquarium. They are thus easily pipetted to new containers for rearing.

Due to eventual contamination of the "culture" water by dead larvae and food material, it is best to change the water every two or three days. This is costly, however, if sea water is hauled to the laboratory. For this reason short, wide-mouthed pint jars are preferable to large containers for rearing jars. The water is changed by pipetting larvae to a clean jar of water. The used jar is then washed and used for the next change. About fifty larvae are originally placed in each culture jar and dead ones removed as time passes. It is advisable to begin with about fifty or more jars as the death rate at the time of molting is high.

The volume of water contained in pint culture jars is small enough that dangerous fluctuation of temperature may occur. This can be overcome by placing the jars in large aquaria which have enough fresh water to cover the bottles to the neck. This procedure will give the same buffering action as a large volume of culture water and still be economical. Extreme summer temperatures may be overcome by (1) controlling laboratory temperature or (2) by making frequent changes of the bath with chilled water. The same techniques would be ideal in a marine laboratory except that running isothermal sea water could be used as a bath for the culture jars.

A food source for the crab larvae is a problem in any laboratory, especially if fresh marine larvae must be gathered daily for feeding purposes. If the crab larvae are large enough, however, newly hatched brine shrimp *(Artemia)* nauplii are excellent for food. *Artemia* eggs can be obtained from any aquarium supply house and hatched out daily in salt water in from twenty-four to thirty hours. It is necessary to use only the smallest of the hatch and to discard older and larger *Artemia* in the culture by changing the water supply.

Finally, aeration of the culture jars is unnecessary, as the ratio of water volume to surface area in the short, pint jars allows ample exchange of gases. Several different techniques were used in aeration, but all proved to be of no value.

Lophopanopeus leucomanus leucomanus (Lockington)

Ovigerous females were collected at Lunada Bay, Palos Verdes, California, on March 28, 1955, and at Smugglers Cove, Santa Cruz Island, California (Velero Station 3023-55), on April 2, 1955. Newly deposited eggs were dark purple-brown, changing to light gray prior to hatching. The larval development was completed in five to seven weeks after hatching.

Prezoea (Plate 17, Figure 1). Measurements: Body 1.40 mm. from front of head to tip of telson, carapace 0.47 mm. long by 0.30 mm. high.

Description: Carapace smooth, dorsal and lateral spines telescoped, rostral spine short and conical.

Antennule finger-like. Antenna telescoped and shortened. Mandibles and maxillae rudimentary.

First and second maxillipeds rudimentary, natatory "hairs" contained within the exopodites.

Abdomen of five segments. Telson telescoped, exposing only the dorsal spines and fork tips.

First zoea (Plate 17, Figure 2 and Plate 18). Measurements: Body 1.65 mm. long from tip of telson to front of head. Dorsal spine 0.61 mm., rostral spine 0.61 mm., distance from the tip of the dorsal spine to the end of the rostral spine 1.60 mm.

Description: Carapace with all spines present. Dorsal, lateral (Plate 18, Figure 5), and rostral spines smooth.

Antennule (Plate 18, Figure 4) conical and smooth, with two long aesthetes at the tip. Antennal protopodite (Plate 18, Figure 3) swollen at base and tapering distally, with a small exopodite (0.15mm.), without an endopodite, with many medium and large spinelets on the distal third. Mandibles and maxillae were not dissected.

First maxilliped with median "hairs" on protopodite, four natatory "hairs" on tip of exopodite, and one, one, one, two, and three "hairs" on the five segments of the endopodite. Second maxilliped normal, with three terminal "hairs" on the three segmented endopodites, and four terminal natatory "hairs."

Abdomen of five segments, with spinelike projections on the midlateral surfaces of segments two and three, with moderate points on the posterolateral margins of segments three, four, and five. Rudimentary sixth segment can be seen within the telson. Pleopods not evident.

Telson (Plate 18, Figure 2) forked, without lateral spines, with one dorsal spine and three barbed median spines per fork. The first median spine with several longer "hairs" about one fourth of its length from the proximal end.

Second zoea (Plate 17, Figure 3). Measurements: Body 1.95 mm. long. Dorsal spine 0.67 mm., rostral spine 0.67 mm., distance from tip of dorsal to end of rostral spine 1.83 mm.

Description: Carapace with all spines present. Rostral and lateral spines smooth, tapering to a point. Dorsal spine with very fine lumps on distal third.

Antennule conical, with a cluster of "hairs" at the tip. Antennal protopodite as long as rostral spine, with short exopodite and a cluster of spinelets around tip portion. Mandibles and maxillae not dissected or diagnosed.

First maxilliped normal, with a few "hairs" on the dorsal edge of the protopodite, endopodite five-segmented, exopodite two-segmented with six terminal natatory "hairs." Exopodite of second maxilliped with seven terminal natatory "hairs." Rudimentary chelae and pereiopods present.

Abdomen five-segmented, with mid-lateral projections on segments two and three; posterolateral spines on segments three, four, and five proportionally longer than in first zoeal-stage. Telson armed as first zoea.

THIRD ZOEA (Plate 17, Figure 4). Measurements: Body 2.13 mm. long from tip of telson to front of head. Dorsal spine 0.88 mm., rostral spine 0.75 mm., distance from tip of dorsal spine to end of rostral spine 2.18 mm., antenna as long as rostral spine.

Description: Carapace with all spines present. Rostral and lateral spines smooth. Dorsal spine with minute lumps (seen only under high power).

Antennule conical, with several aesthetes at tip. Antennal protopodite long, tapering to a point; with a short (0.03 mm.) exopodite and a moderate (0.10 mm.) endopodite with a cluster of spinelets around the tip. Mandibles and maxillae were not dissected or diagnosed.

First maxilliped with five "hairs" on lateral margin of protopodite, endopodite with one, two, one, one and three "hairs" on its five segments, exopodite with eight natatory "hairs" at tip. Exopodite of second maxilliped with nine natatory "hairs" at tip. Rudimentary chelae and pereiopods present.

Abdomen of six segments, the first five armed as in second zoea, the spines proportionately longer. Rudimentary pereiopods present. Telson armature unchanged.

FOURTH ZOEA (Plate 17, Figure 5). Measurements: Body 2.87 mm. long from tip of telson to front of head. Dorsal spine 1.10 mm.; rostral spine 1.03 mm.; distance from tip of dorsal spine to end of rostral spine 2.86 mm.

Description: All spines present on carapace. Rostral and lateral spines smooth. Dorsal spine with a few minute lumps on tip region.

Antennule conical, segmented, with aesthetes at tip. Antennal protopodite swollen at the base, narrowing sharply to a point; with anterior and posterior spinelets at the tip. Antennal endopodite one third length of protopodite. Mandible bilobed with four teeth on the posteroventral margins. Maxillae not diagnosed.

The first maxilliped endopodite with one, two, two, one, and three "hairs" on its five segments. Exopodite of first maxilliped with nine natatory "hairs"; exopodite of second maxilliped with ten natatory "hairs." Third maxilliped, chelae and pereiopods rudimentary.

Abdomen six-segmented, with midlateral, spinelike processes on segments two and three; long (0.42 mm.) posterolateral spines on segments three, four, and five. Segment six unarmed. Rudimentary pereiopods and uropods present. Telson armature unchanged.

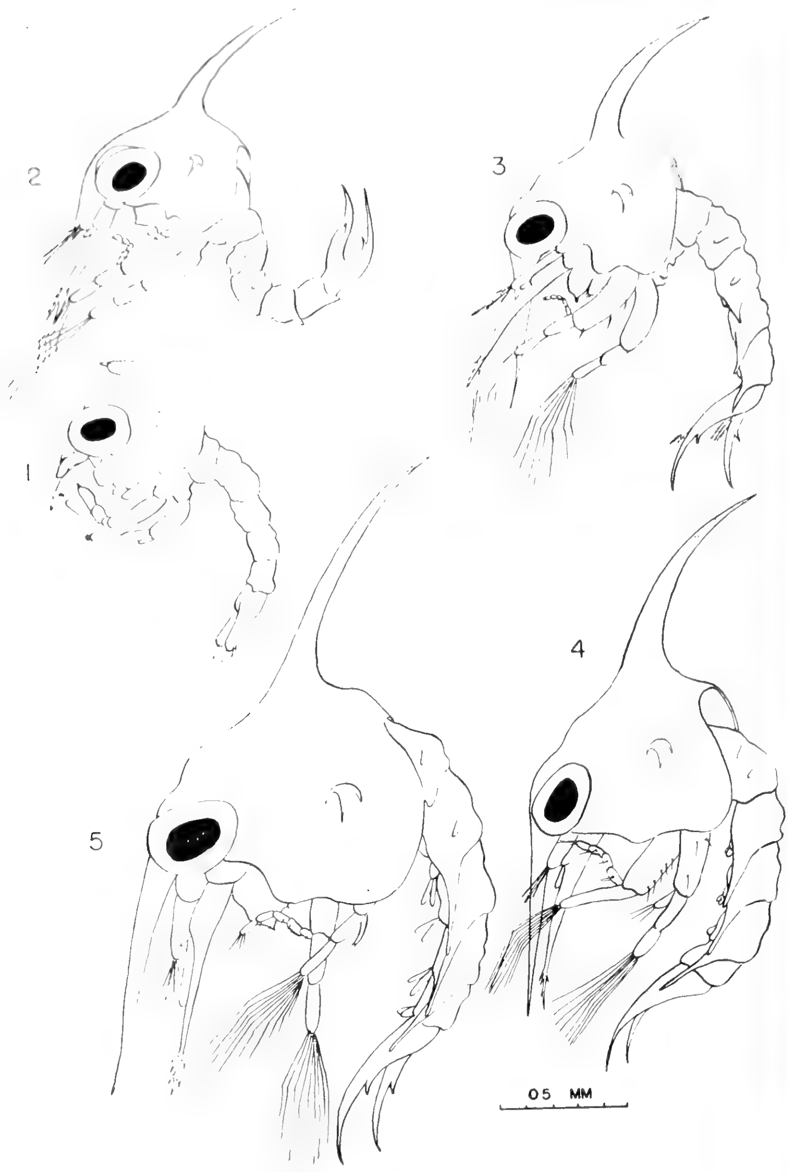

PLATE 17

Lophopanopeus leucomanus leucomanus (Lockington): fig. 1, prezoea; fig. 2, first zoea; fig. 3, second zoea; fig. 4, third zoea; fig. 5, fourth zoea.

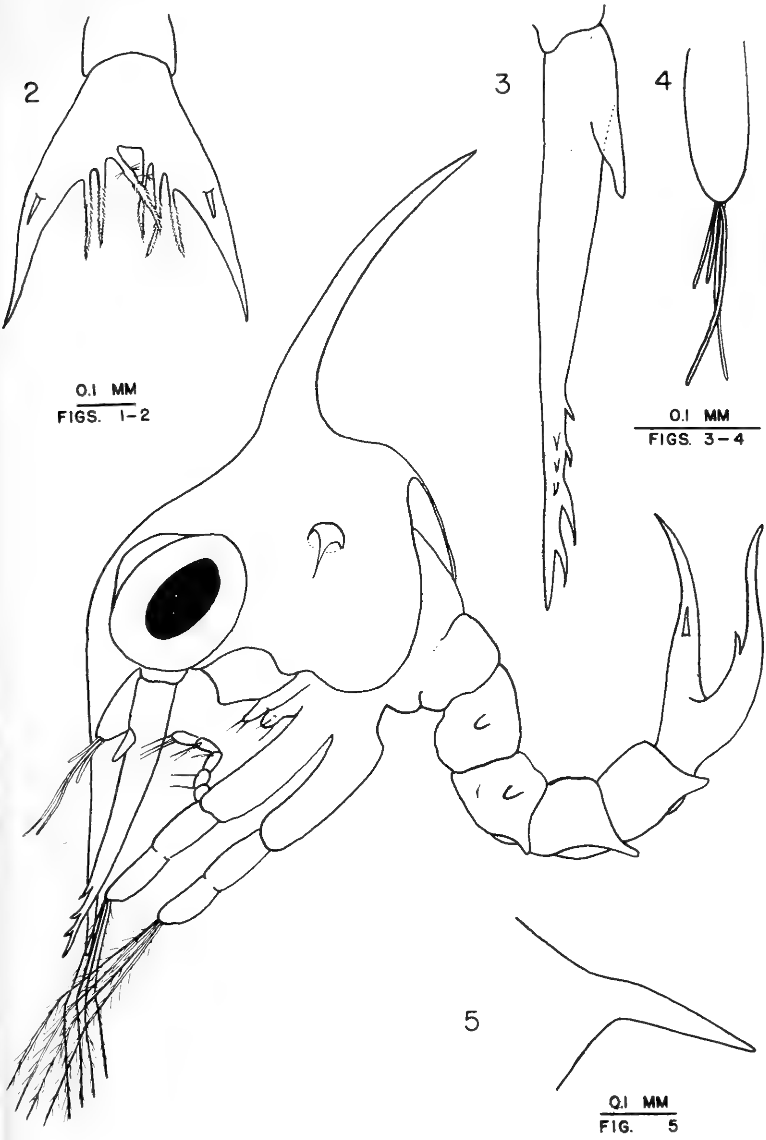

PLATE 18

Lophopanopeus leucomanus leucomanus (Lockington) first zoea: fig. 1, first zoea, lateral view; fig. 2, telson; fig. 3, antenna; fig. 4, antennule; fig. 5, lateral spine.

Megalops (Plate 19, Figure 1). Description: Surface of carapace smooth, with marginal setae and scattered "hair" throughout. Front broad with rectangulate frontolateral projections, but lacking tooth on anterior corner. Rostrum squared, decurved, and short. Mid-dorsal protuberance present but not conspicuous. Distance between eye tips greater than greatest carapace width.

Antennule (Plate 19, Figure 7) swollen at basal segment containing statocyst, third segment with a two-segmented flagellum bearing a terminal bristle, and a four-segmented flagellum with aesthetes on segments one to three, and a terminal bristle on four.

Antenna (Plate 19, Figure 9) eleven-segmented, with a whorl of "hairs" on segments eight and ten, and a terminal tuft of "hair." Second maxillae (Plate 19, Figure 3) with hair on median surface of endopodite and with marginal plumed "hair" around the exopodite; two bilobed endites, the first with six and two setae, and the second with five and eight setae.

First maxilliped (Plate 19, Figure 4) with a two-segmented exopodite bearing five plumed "hairs"; endopodite monosegmented with three terminal setae; endite two with thirteen marginal setae; endite one with seven setae. Second maxilliped (Plate 19, Figure 5) with five plumous "hairs" on end of two-segmented exopodite; endopodite with zero, zero, five, and two setae from merus to dactylus and five stout terminal spines on dactylus. Third maxilliped (Plate 19, Figure 6) with five terminal "hairs" on exopodite, and with one, twelve, five, three, two, and six setae from basis to dactylus and two terminal spines. Cheliped with short ischial hook. Last dactylus with three specialized "hairs."

Abdomen of six segments and a telson. Pleopods with 16, 14, 14 and 14 plumous "hairs" (Plate 19, Figure 8); uropods with eight. Telson (Plate 19, Figure 10) with three terminal setae.

Remarks. Of all of the known zoeae of the California Xanthidae the members of the genus *Lophopanopeus* differ from the other genera in that they possess smooth lateral spines. *Lophopanopeus leucomanus leucomanus* can be separated from *Lophopanopeus bellus bellus* and *Lophopanopeus bellus diegensis* in that the later two species have no spinelets on the antennal protopodite.

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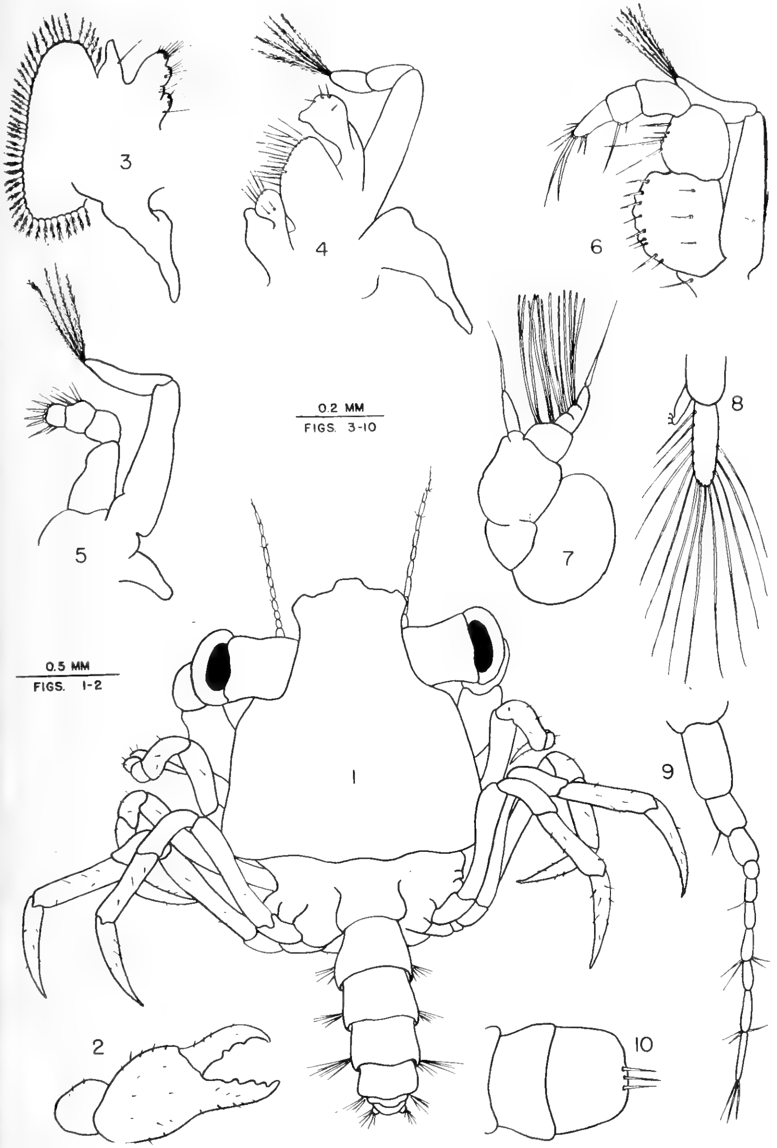

PLATE 19

Lophopanopeus leucomanus leucomanus (Lockington) megalops: fig. 1, megalops, dorsal view; fig. 2, chela; fig. 3, second maxilla; fig. 4, first maxilliped; fig. 5, second maxilliped; fig. 6, third maxilliped; fig. 7, antennule; fig. 8, pleopod; fig. 9, antenna; fig. 10, telson.

PROCEEDINGS OF THE ACADEMY

December 13, 1957

The Section on Earth Sciences sponsored the regular December meeting of the Academy, which was held on the second Friday of the month in order to avoid conflict with the Christmas holidays.

The speaker, Dr. H. B. S. Cooke, of the Department of Geology, University of Witwatersrand, Johannesburg, South Africa, is visiting this country as research fellow at the University of California, Berkeley. He is a leading authority on Pleistocene Geology, Vertebrate Paleontology and Archeology of South Africa. Approximately 230 members and guests of the Academy assembled to hear Dr. Cooke's excellent exposition of the recent work on "ICE AGE MAMMALS OF SOUTH AFRICA." The meeting was held in the main lecture hall of the Los Angeles County Museum, in order to accommodate the large crowd.

Abstract of Dr. Cooke's Talk

During the past half million years, when ice sheets advanced and retreated four times over much of North America, the tropical land of Africa suffered sympathetic increases and decreases in rainfall. In the early part of this period, about the time of the first interglacial, South Africa was inhabited by a variety of extinct mammals, including the important ape-men (Australopithecines) first identified in 1925 by Professor Raymond Dart. The first discovery was the skull of a child and adult remains were not discovered until 1936, when Dr. Robert Broom began a succession of finds in the Transvaal. These ape-men were erect creatures with small bodies and relatively large brains. They had flexible hands, and primitive pebble tools have recently been found with them. They are too late to be the actual ancestors of true man but are regarded as representing somewhat degenerate survivors of the stock from which man arose. The extinct animals which lived at the same time include saber-toothed cats—somewhat like those of Rancho La Brea—as well as peculiar chalicotheres, sivatheres, giant wart-hogs and many types of buck which no longer exist. After the time of the ape-men, some extinct animals continued to live side by side with men who hunted with stone fist-axes through the time of the second and third glacial periods. About the time that man reached North America, the last of the peculiar extinct animals died out in Africa but there are fossil remains of man himself. Africa may well prove to be the ancestral home of the whole human family.

The following new members were elected:

Bright, Donald B., Dept. Biology, U.S.C. (Biology); Calkins, Virgil F., 4220 Francis Ave., Seattle, Wash. (Entomology); Merriam, Richard, Dept. Geology, U.S.C. (Geology); Reish, Donald J., Allan Hancock Foundation, U.S.C.; Thomas, Robert G., 605 North Toland Ave., West Covina (Geology); Weissman, Donald D., 1225 Harvard St., Santa Monica (Dentistry); Flaum, Eugene J., 6123 Eileen Ave., Los Angeles 43 (Jr. member) (Zoology); Pidot, Ronald K., 2522 Virginia Ave., Los Angeles, (Jr. member).

January 17, 1958

The January meeting of the Academy, sponsored by the Section on Entomology, was held in the Education Lecture Hall of the Los Angeles County Museum, with fifty-one members and guests present. The speaker, Dr. Stanley E. Flanders, of the Citrus Experiment Station, Riverside, California, presented the results of his research concerning "REGULATION OF CASTE AND OF SEX IN SOCIAL HYMENOPTERA."

Abstract of Dr. Flanders' Talk

Caste and sex are correlated phenomena in the social Hymenoptera. The castes are entirely female. There appears to be a strong tendency in the whole order toward complete femaleness, notably in the saw flies and in the parasitic Hymenoptera. This tendency seems least evident in the Serphoidea. In species that reproduce uniparentally the male, if it occurs at all, is useless and possibly detrimental (except in species in which uniparental reproduction can be environmentally changed to biparental reproduction).

The hymenopterous female originates from a diploid egg, the male from a haploid egg. The deposited female-producing egg is one of three types: I. diploid as a result of fertilization; II. diploid as a result of failure of the reduction division; III. diploid as a result of the reduction division, such an egg being originally tetraploid. In the social Hymenoptera, the female (worker or queen) is usually derived from a fertilized Type I egg. The worker presumably develops only from an egg that has lost a certain amount of yolk as a result of prolonged retention in the ovary. The queen, however, is derived either from a yolk-replete egg or from a worker larva or worker adult that is fed special foods.

The correlation between sex and caste hinges on (1) the fact that the fertilization of the egg, as in all Hymenoptera, is completely dependent on environmental stimulation of the spermathecal gland, the secretions of the gland being required for the activitation of the sperm, and (2) the synchronization of environmental conditions that stimulate the gland with those that cause prolonged ovarian retention so that most of the fertilized eggs have a reduced amount of yolk. Yolk reduction is effected by ovisorption, an essential process in species having highly specialized oviposition dependent on external stimuli.

Colony conditions that inactivate the spermathecal gland (and result in high male populations) are designated "opulent"; colony conditions that activate the spermathecal gland are designated "indigent". Under indigent conditions, which usually are inducive to colony growth, most eggs are fertilized and develop into workers. When conditions are opulent, colony growth is largely if not entirely completed, and egg fertilization is accomplished only by sperm held over in the sperm duct, so that most of the eggs remain haploid and develop into males.

Differences in the form and structure of the social colony determine the operation of the caste-determining mechanisms. Colony structure varies according to whether the feeding of the larvae is segregated in time or in space (as in the army ants and honey bees), or is not segregated (as in the Argentine ant, stingless honey bees, and social wasps). In the first case all ovarian eggs are supposedly predisposed to become workers; extra feeding of worker larvae produces queens. In the honey bee, the queen's larval diet contains, according to R. E. Snodgrass, a substance that suppresses the worker characteristics. In the second case, not all ovarian eggs are predisposed to become workers; some become queens regardless of larval feeding.

Board of Directors

The following business was transacted at a meeting of the Board of Directors after the program on January 17, 1958.

By motion passed, the Academy accepted the invitation from the Southern California Science Fair to act as one of the sponsors of the 1958 Fair to be held at the Los Angeles County Museum on April 13-25.

The following committees were named by the president and approved by the Board: Nominating Committee, Sherwin F. Wood, Chairman, Dorothy Martin and Charles Burch; Committee on selection of Fellows, Fred S. Truxal, Chairman, George Johnston and William Easton; Committee on A.A.A.S. grants-in-aid, Louis C. Wheeler, Chairman, Sherwin F. Wood and John D. Soule.

A resolution to petition the Planning Commissions of the City and County of Los Angeles to recommend the preservation, in a natural state, of the acreage in the Big Tujunga Basin containing one of the finest collections of yucca and other desert-type flowers in southern California, was passed, and the president instructed to send a copy to these Commissions.

The following new members were elected: Anthony, Steven, 248 San Gabriel Ct., Sierra Madre (Entomology; Junior member); Baird, John J., Long Beach State College (Embryology); La Rivers, Ira, Dept. Biology, University of Nevada (Entomology); Rosenbaum, Arthur, 13453 Weddington St., Van Nuys (Engineering); Menke, Arnold, 6211 7th Ave., Los Angeles 43 (Entomology; Junior member).

February 21, 1958

Dr. Robert L. Reeves, D.D.S., head of the Department of Oral Pathology and Periodontics, School of Dentistry, Univ. of So. California, presented the address at the February meeting of the Academy. The meeting was held at the Los Angeles County Museum with 58 members and guests present. The program was arranged by the Academy's Section on Health.

"THE ROLE OF SCIENCE IN DENTAL EDUCATION"

Abstract of Dr. Reeves' Talk

The layman often thinks of dentistry as being almost entirely mechanical in nature. Dentistry was first concerned with the relief of pain and the restoration of function, which led to the early development of exodontics (tooth extraction), prosthetic dentistry (replacement of missing teeth) and operative dentistry (filling of teeth). Any consideration of the mouth as a part of the body from a health standpoint was vague.

Since these early days, there has been increasing emphasis placed on the biology of the oral cavity and upon research based on sound experimental principles. The dental student is taught to consider the mouth as an integral part of the human body, not just a box containing teeth. Present day dental education not only exposes the student to the basic disciplines of anatomy, histology, biochemistry, physiology, bacteriology and pathology but it applies and correlates these subjects to practice.

The cost of dental and oral disease has been estimated to be about 1½ billion dollars a year, or 15 per cent of the total cost of health services. In spite of this, the majority of the population does not receive adequate dental care. Even though a few new dental schools have been recently organized and several schools have increased their enrollment, the number of dentists per capita is decreasing.

By far the greatest amount of time and money spent by the public on dental care results from the prevalence of two disease processes—dental caries and periodontal disease. Dental caries has been studied for many years and yet the exact etiology and mechanism is not clear. Some measure

of prevention is now available through fluoridation of drinking water but additional methods of control are necessary. The subject of periodontal disease is even more a mystery to most laymen and to many scientists. This field has received increased emphasis in most dental schools in the past few years, but a great deal is yet to be known.

An expanded program of dental research is essential. Actually very little money is spent on dental research. The Federal budget of 1956-1957, for example, called for less than $3,000,000 for research in dentistry out of $126,500,000 for all research in health fields. Recently the U.S. Public Health Service had forty approved research projects in dentistry for which no funds were available. There are a number of reasons for this situation, among which is an attitude, possibly held by biologists outside the field of dentistry as well as laymen, that dental research must be confined within the physical limitations of the oral cavity. Also, as people do not ordinarily die of dental disease, the feeling of urgency is missing.

Board of Directors

The Board of Directors met after the program on February 21, 1958, and the following business was transacted:

Dr. Sherwin F. Wood, Chairman of the Nominating Committee, announced the Committee's slate of nominees for Directors and Advisory Board for 1958-1959. The slate was approved for transmittal to the membership for voting before the annual meeting.

A committee on arrangements for the Annual Meeting was named by the President as follows: Fred S. Truxal, Chairman, Mrs. Truxal, Mr. and Mrs. J. Stanley Brode, Mr. and Mrs. Russell E. Belous, Mr. Hugh Austin.

By motion passed, the Treasurer was authorized to use the two "Rights to buy" issued by American Telephone and Telegraph Inc., and purchase two debentures at $100 each.

The following persons were elected to membership: Emmel, Tom, 5341 West Blvd., Los Angeles (Entomology; Junior member); Gillaspy, James E., 662 William St., Pomona (Entomology); Overton, Thelma, 1023 So. Fremont, Yucaipa (Chemistry; Limited member).

March 21, 1958

Instead of the regular meeting in March, members and guests of the Academy were given a conducted tour of the U.S. Steel Plant at Torrance, California. Forty-four were present.

EARTH SCIENCES SECTION MEETINGS

The Section of Earth Sciences was invited to dine and meet at Webb School in Claremont, on Friday, December 6, 1957. About twenty geologists, paleontologists, zoologists and anthropologists gathered at Ray Alf's Museum of Paleontology on the Webb campus at 5:30 P.M. and had the opportunity of viewing fossil material collected throughout the United States by Mr. Alf and his students. Following dinner in the school dining hall, a group of about thirty, including students of the school, met in the Library for the evening program led by Allen Bassett of the U.S. Geological Survey. The subject, "HISTORY OF THE MOJAVE DESERT PLEISTOCENE LAKE SYSTEM," was discussed at some length by Mr. Bassett, with questions and comments from the group.

The third meeting of the Earth Sciences Section was held at the University of Southern California, Room 352, Science Building, with 25 present. Several of the group met at Carl's Restaurant on Figueroa Street prior to the meeting for dinner and informal "shop talk."

The evening discussion on "TEMPO AND MODE IN INSULAR EVOLUTION" was led by Dr. Andrew Starret and Dr. Jay Savage of the U.S.C. Department of Biology. Dr. Starret discussed the mammalian population of Cape Cod and adjacent islands, and Dr. Savage reviewed the reptiles of Baja California and the Sea of Cortez.

SCIENTIFIC NOTES

AN IMPORTANT PUBLICATION ANNOUNCEMENT FOR ENTOMOLOGISTS AND LIBRARIANS

The Proceedings of the Tenth International Congress of Entomology, held in Montreal, Canada, in August, 1956, are expected to be ready for distribution in late 1958. The price is $75.00 postpaid for the set of four volumes. Since a limited number will be printed only orders received before May 1, 1958, can be guaranteed.

The Proceedings will contain nearly 700 scientific contributions, many accompanied by illustrations. The four volumes, comprising over 4200 pages, will constitute an indispensable work of reference for many years since most of the material is not being published elsewhere.

For further information write to the address below:

Tenth International Congress of Entomology,
Science Service Building,
Ottawa, Canada.

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NOTES ON PACIFIC COAST MARINE ALGAE VII

By E. Yale Dawson[1]

The collections of marine plants currently being obtained for the California Water Pollution Control Board and intended to contribute to a biological survey of the continental shelf of southern California from Point Conception to the Mexican boundary, have yielded a number of specimens representing range extensions of known species, and have brought to light several species which apparently have not heretofore been described. Unless otherwise indicated, the specimens are cited with the writer's field collection numbers and are deposited in the Herbarium of the Allan Hancock Foundation, University of Southern California.

The writer thanks Mr. Michael Neushul for several contributions to this study.

Cladophoropsis fasciculata (Kjellm.) Börg.

Two collections are at hand which compare favorably with this species well known in the warmer, southern parts of Japan, but not heretofore reported for the eastern Pacific region: *16184,* just north of Dana Point, Orange Co., 2/24/57; *16375,* Lechuza Point, Los Angeles Co., 3/14/57.

Leathesia nana Setch. & Gard.

Known heretofore only from the region of the Monterey Peninsula, this species was found in abundance at Carpinteria Beach State Park, *17466,* 11/26/57.

Soranthera ulvoidea Post. & Rupr.

Setchell and Gardner (1925) say of this species "common along the whole coast from Unalaska, Alaska to southern California." Smith (1944) says, "Alaska to central California (Monterey Peninsula)." No definite southern California localities appear in the literature, and the presently reported collection seems to represent its southern limit: *16592,* Government Point, Santa Barbara Co., 5/16/57.

Phaeostrophion australe sp. nov.

Plate 20, Fig. 1

Thalli 1.5-2.5 (4) cm. altitudine, subnigri; laminae simplices ad stipitem complanatum 150-350 μ diametro in basi anguste cuneatae, ad 1.0-1.5 cm. lat., 155-175 μ crass. expansae, partibus superioribus plerumque laceratis; transsectio praebens medullam

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ca. 70 μ crass. e cellulis 15-25 μ diam. compositam, atque corticem intrinsecus e cellulis parvis quadratis, extrinsecus e cellulis elongatis valloformibus constatem; cellulae zoosporangiales magnae, ellipticae ad elongata, subrectangulares, 35-40 μ long. inter cellulas corticis exteriores.

Thalli 1.5-2.5 (up to 4) cm. tall, blackish in color, consisting of several complanate blades arising from the surface of a crustose basal attachment; erect blades simple, the margins entire, narrowly cuneate to a flattened stipe 150-350 μ in diameter at the base, expanded to 1.0-1.5 cm. wide above, but the upper parts eroded and lacerate to irregular lobes and lacineae; blades about 155-175 μ thick, in transection showing a medulla about 70 μ thick of angular pseudoparenchymatous cells mostly 15-25 μ in diameter, and a cortex of small, quadrate cells on the inside and elongate, palisade-like cells to the surface separating the large elliptical to elongate, subrectangular zoosporangial cells 35-40 μ long; other reproduction not seen.

Type: *Dawson 16618,* approximately 160 feet from the base of the bluff at the end of Government Point, Santa Barbara Co., Calif., May 16, 1957.

This genus has been known heretofore only from the type species, *Phaeostrophion irregulare* Setchell & Gardner, from Coos Bay, Oregon and from Bolinas, California. *P. irregulare* is a much larger species 15-25 cm. tall, or reaching 40 cm., and usually of a light brown to olive-greenish color. Structurally and reproductively it is much like the present plant, but the great disparity in size as well as the marked geographic discontinuity set the two well apart.

Laminaria sinclairii (Harvey ex Hooker f.) Farlow, Anderson & Eaton.

The following records extend the known range of this species southward from Gaviota, Santa Barbara Co.: *15476,* Mussel Shoals, Ventura Co., 11/19/56; *15517,* 2 miles northwest of Ventura, 11/29/56; *15914,* Carpinteria Beach State Park, Ventura Co., 1/13/57; *17476, 17504,* same, 9/26/57.

Fucus gardneri Silva

This species is widely known along the Pacific Coast from San Luis Obispo County to Sitka, Alaska. The present materials, found growing sparsely in restricted colonies at Government Point, Santa Barbara Co., *16621,* 5/16/57, apparently represent the extreme southern limit of its range.

H. T. Powell (1957) has reduced this name under *Fucus distuhus* L. Emend Powell Subsp. *edentatus* (De la Pyl.) Powell.

Gelidium venturianum sp. nov.

Plate 20, Fig. 2, Plate 21, Fig. 5

Thalli ad 3.5 cm. alt., conferte fasciculati, ex axibus pluribus planis identidem congeste pinnatim ramosis constantes; axes

principales ca. 1.2 mm. lat., 250 μ crass. in centro, tenuiores in marginibus, pinnas breves determinatas ascendentes necnon ramos indeterminatos saepenumero irregulariter arcte pinnatim ramosos, omnibus omni in plana contortis conferte congestis factis, habentes; ramuli superiores 250-400 μ lat., ca. 100 μ crass.; apices acuti, initia pinnarum admodum post cacumina praebentes; transsectio partium inferiorum rhizinas plurimas per corticem interiorem atque medullam, rhizinis medullae centralis partim perspicue intextis, non rectis, praebens.

PLATE 20

Figure 1. *Phaeostrophion australe* sp. nov. Three plants from the type collection, X 1.8. Figure 2. *Gelidium venturiana* sp. nov. Portions of two plants from the type collection, X 1.8.

Thalli to 3.5 cm. tall, densely clumping, consisting of several repeatedly and congestedly pinnately branched flat axes; main axes about 1.2 mm. broad, 250 μ thick in the center, thinner at the margins, provided below with short, determinate ascending pinnae as well as determinate branches which are many times irregularly and closely pinnately branched, all becoming twisted in all planes and densely congested; upper branchlets 250-400 μ wide, about 100 μ thick; apices acute, showing initials of pinnae immediately back of the tips; transection of lower parts showing a great abundance of rhizines throughout the inner cortex and medulla, those of the central medulla in part distinctly interlacing, not straight; reproduction not seen.

Type: *Dawson 15486*, on exposed rocks subject to heavy surf and spray just beyond the limits of ebb tides, Mussel Shoals, Ventura Co., November 19, 1956.

This species shows several resemblances to *Gelidium coulteri* in size, distichous branching and in the presence of short, determinate pinnae in lower parts, but the aspect of the entire plant is so different in the density of branching, and in the twisting and matting of the congested upper parts, that it cannot satisfactorily be identified with that species. It is apparently a rare plant, for, although many collections have been made in similar habitats both north and south of the type locality, no other material like this has yet appeared. A search for additional specimens failed in October 1957 in the vicinity of the type locality.

Pterocladia media sp. nov.

Plate 21, Fig. 3, 4. Plate 24, Fig. 11.

Thalli conferte fruticulosi, ad 3 cm. altitudine, constantes e partibus erectis ramosissimis e systemate partium stoloniferarum repentium, per haptera brevia paxilliformia crebro affixatum, orientibus; axes ligulati infra ca. 140 μ lat., supra 300-400 μ lat.; partes superiores axium erectorum fasciculos unum vel plures ramulorum crebrorum distichosorum determinatorum compressorum plerumque solum 1-1.5 mm. long. evolventes; transsectio medullam interiorem angustam constantem e cellulis tenuibus longissimis incoloratis 8-10 vel plus longioribus quam latis praebens; rhizinae rarissimae per linaeam medullarem intimam parce dispersae, in transsectionibus nonnulis ut videtur absentes.

Thalli densely tufted, to 3 cm. tall, consisting of many branched, erect parts arising from a system of stoloniferous, creeping parts attached at close intervals by short, peg-like holdfasts;

both creeping and erect parts flattened and more or less ligulate, about 140μ wide below and expanded above to 300-400 μ wide, 100-140 μ thick; erect axes at first simple or sparingly indeterminately branched, usually by proliferations from broken ends, but in upper parts developing one or more groups of many closely set, distichous, determinate, compressed branchlets mostly only 1.0-1.5 mm. long; apical cell usually readily observed at the blunt to

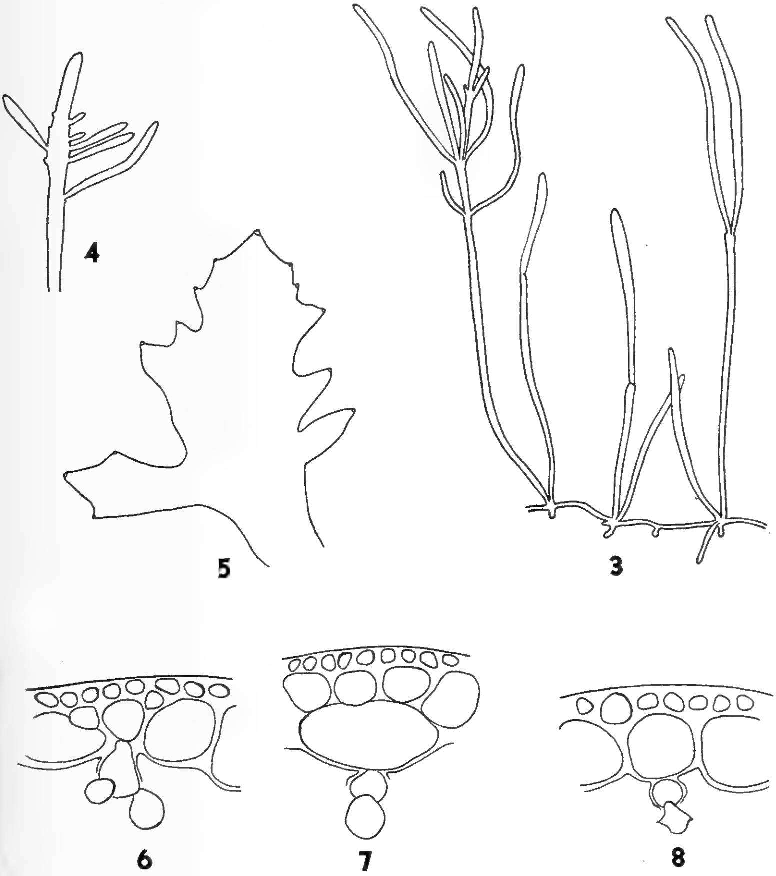

PLATE 21

Figures. 3-4. *Pterocladia media* sp. nov., Figure 3. Part of a plant of the type collection to show the creeping parts and peg-like holdfasts, X 4; Figure 4. Detail of the upper part of a mature erect axis to show the closely spaced pinnae, X 5. Figures 6-8. *Botryocladia neushulii* sp. nov. Three examples of compound gland cells from different specimens, X 218.

Figure 5. *Gelidum venturiana* sp. nov. Apex of an upper branch showing ultimate branchlets and initials, X 38.

acute axis tips; transaction showing a cortex and outer medulla of 3-4 cell layers of heavily pigmented isodiametric to elongate ellipsoidal cells and a narrow inner medulla of slender, much elongated, pale cells 8-10 or more diameters long; rhizines extremely scant and apparently absent from some sections, when observable, sparsely scattered in the innermost medullary line; reproduction not seen.

Type: Dawson *15609*, intertidal above the reef flat, opposite the north end of Neptune Place, La Jolla, California, December 1, 1956.

This species is intermediate in size between the very small ones such as *Pterocladia musciformis* Taylor, P. *caloglossoides* (Howe) Dawson, and P. mcnabbiana Dawson, and the larger *P. pyramidale* (Gardner) Dawson and *P. complanata* Loomis. It seems to be mostly closely related to *P. parva* Dawson which is known only from a dissimilar environment at San Felipe in the northernmost Gulf of California. From that species it differs in its stature (about 3 cm. instead of 1.5 cm.) and in the extremely scant răther than abundant rhizines.

Gloiosiphonia californica (Farl.) J. Ag.

Heretofore unreported between Santa Barbara, California and Punta Baja, Baja California, the present collection helps to fill this discontinuity: *15300*, intertidal rocks opposite Yerba Buena Road, Ventura Co., 11/17/56.

Jania natalensis Harvey

This has been reported on the Pacific Coast from a number of localities along northern Baja California and southern California to as far north as Point Dume Bay. Collections from Lechuza Point, *16376*, 3/14/57, and from Arroyo Sequit, *15383*, 11/18/56, extend the range still farther north.

Bossiella ligulata (Dawson) Silva

This species has been known heretofore only from the type collection from Isla Guadalupe, Mexico. Two additional sets of specimens are among the present collections, namely, *15510*, from Ventura, 11/29/56, and *15875*, from the Port Hueneme breakwater, Ventura Co., 12/20/56. The plants of the latter collection are remarkable in luxuriance and in the fact that they were growing in almost pure stands (or with *B. sagittata)* on rocks subject to sewage pollution from an outfall upcurrent only 25-40 feet away.

Bossiella sagittata (Dawson & Silva) Silva

Well known from several localities among the southern California Channel Islands and from Baja California, but not heretofore reported from mainland California. Abundant, alone or with *B. ligulata,* at the end of Port Hueneme breakwater and subject to marked sewage pollution, *15876*, 12/30/56.

Bossiella insularis (Dawson & Silva) Silva
Previously known from the southern California Channel Islands, from La Jolla, California and several Baja California localities, this species was found in pure stands within 25 feet of the sewer outfall, Port Hueneme breakwater, *15861*, 12/30/56.

Corallina pinnatifolia (Manza) Dawson
This plant is well known in southern California and southward, but has not been reported north of Dana Point, Orange County. The present collection, *15886*, is from Carpinteria, Santa Barbara Co., 1/13/57.

Prionitis cornea (Okamura) comb. nov.
Following the conservation of *Prionitis* this combination needs to be made for the plant known in the literature under several other names: *Grateloupia cornea* Okamura 1913:63; *Carpopeltis cornea* (Okamura) Okamura; *Prionitis linearis* Kylin; *Zanardinula linearis* (Kylin) Papenfuss; *Zanardinula kylinii* Doty.

Cryptonemia angustata (Setch. & Gard.) Dawson
This species has been reported for California only from drift at Mission Beach. It has recently been collected by Mr. Neushul growing intact at a depth of 40-50 feet on the inner edge of the kelp bed off south La Jolla, *16947*, *16949*, 6/1/57.

Meredithia californica J. Ag.
A small, peltate red alga growing on a limpet brought up from a depth of 30-40 feet off south La Jolla by Mr. Neushul, *16940*, 6/1/57, seems to belong to this poorly known species.

Grateloupia prolongata J. Ag.
A specimen from small intertidal pools at Gaviota Beach Park, Santa Barbara Co., *15802*, 12/18/56, represents a northward extension of the known range from Ventura, California.

Hypnea johnstonii Setch. & Gard.
A rich development of sterile plants of what appears to be this species was found by Mr. Anthony M. Nadakal on sand flats of Newport Harbor, east of the highway near the cement factory, Feb. 21, 1957. *H. johnstonii* has not been reported previously from California. It was growing in an area which in 1948, previous to the harbor dredging, was occupied by *Gigartina tepida*. Both of these species are characteristic of many parts of the Gulf of California.

Phyllophora californica (J. Ag.) Kylin
This species is known in the literature only by the fragmentary type specimen from Fort Point, San Francisco, California. The type is illustrated by Kylin (1931) and has been matched satisfactorily with several southern California specimens of recent

collection. Furthermore, the illustration by Smith (1944, pl. 63, fig. 5) of a plant under the name *Phyllophora clevelandii* suggests *P. californica* instead of *P. clevelandii* which is not otherwise known from northern California. The following collections outline a range in southern California: *15780*, Ventura, 12/16/56, in drift; *16377*, Lechuza Point, Los Angeles Co., lowest intertidal, 3/14/57; *17369*, same locality, in drift, 7/29/57; *16577*, Government Point, Santa Barbara Co., in drift, 5/16/57. In some of these, small, deciduous, proliferous "leaflets" 1.0-1.5 mm. long occur along the edge and on the surfaces of upper segments and appear to function as vegetative reproductive gemmules. Mr. Neushul reports observing similar "leaflets" on *P. clevelandii* at La Jolla.

Gigartina asperifolia J. Ag.

This has remained a poorly known species and is apparently not a common one in southern California. The type came from "Santa Barbara" without more definite locality, and the writer has recently found several plants in good agreement with Setchell and Gardner's type photograph (1937a:270, pl. 50) at Goleta Point, on lower intertidal rocks, *16490, 16528*, 4/12/57.

Rhodoglossum americanum Kylin

This species is well known in northern California from Bolinas to Carmel, and in the south from several localities between San Diego and Bahía Viscaino, Mexico. The present collections are from its middle range: *16491, 16513, 16527*, Goleta Point, Santa Barbara Co., 4/12/57; *17343*, Lechuza Point, Los Angeles Co., 7/29/57.

Rhodoglossum linguiforme sp. nov.

Plate 22, Fig. 9.

Thalli 20- 30 μ altitudine, ex aliquot ad plures laminis erectis stipitatis complanatis, e disco parvo compacto orientibus, constantes; laminae erectae ligulatae 2-3.5 cm. latitudine, simplices aut saepe semel furcatae, extrema in parte linguiformes, oblanceolatae e stipite crasso 3-10 cm. longitudine; lamina in transsectione quasi ubique ca. 550-650 μ crassitudine, plerumque, autem, in marginibus ad 840 μ crass., praebens corticem manifestum confertum ex ordinibus anticlinalibus 6-7 cellularum parvarum, ca. 10 μ diam. intrinsecus, ad superficiem progredienter minorum, longiorumque factarum, compositum, necnon medullam e filamentis densius intextis plerumque 5-10 μ diametro compositam, cellulis medullae 30-60 μ long. in plana laminae saepissime ordinatis atque trans latitudinem extensis; tetrasporangia cruciata, ovata, ca. 30 μ long. in soris parvis, 500-800 μ long. super laminam sparsis atque in lamina inclusis.

Thalli 20-30 cm. tall, consisting of several to many erect, stipitate, complanate blades from a small, compact disc; erect blades ligulate, 2-3.5 cm. wide, simple or often once forked usually in the broader portion of the blade but sometimes at the top of the stipe, oblanceolate from a coarse stipe 3-10 cm. long which is cylindrical below and becomes flattened below the point of expansion of the blade, terminally linguiform; margins for the most part

PLATE 22

Figure 9. *Rhodoglossum linguiforme* sp. nov. A plant from the type collection, X 0.5.

entire, but often with irregularly scattered proliferations; blade in transection about 550-650 μ thick in most parts, but commonly to 840 μ thick at the margins, showing a prominent, dense cortex of anticlinal rows of 6-7 small cells about 10 μ in diameter within, becoming progressively smaller and more elongated to the surface, the medulla of rather densely interlaced filaments mostly 5-10 μ in diameter tending to be arranged in the plane of the blade and running across its width, these made up of cells 30-60 μ long; tetrasporangia cruciate, ovate, about 30 μ long, borne in small sori 500-800 μ in diameter scattered over the blade and embedded in it beneath the cortex; sexual plants not seen.

Type: *Dawson 15415*, at lower low water level and below, rocky shore at Arroyo Sequit, Los Angeles Co., November 18, 1956.

Additional material: *16090*, Arroyo Hondo, Santa Barbara Co., 2/11/57; *15879*, plants growing under polluted conditions at the end of the outer breakwater, Port Hueneme, Ventura Co., 12/30/56, are probably atypical examples of this species.

From the few other species of *Rhodoglossum* known along the Pacific Coast this one is readily distinguished. It is a coarser species than any except *R. coriaceum* which is clearly its nearest relative. It resembles *R. coriaceum* especially in its long stipes which are at first cylindrical and then flattened. The blades are coarse, but only about half as thick as those of *R. coriaceum* which reach 1.4 mm. It differs mainly in its smaller size and narrow, ligulate blades which usually do not exceed 3 cm. Those of *R. coriaceum* are much expanded, up to 15 cm. broad and to 50 cm. tall. Characteristic thick, broad examples of *R. coriaceum* are at hand from the intertidal reef at Willow Anchorage, Santa Cruz Island, *5915*, 12/30/48. Another collection, *15508*, from 2 miles west of Ventura, 11/29/56, is not as thick as most *R. coriaceum* (0.7 mm.) but is 5-6 cm. broad and 55 cm. long. These represent the first California collections of this species.

Iridaea reediae (Setch. & Gard.) Papenfuss

This species is known in the literature only from the type specimen from Bushnell's Beach, San Luis Obispo Co., *Iridophycus reediae* Setchell & Gardner 1937b:172. Specimens corresponding satisfactorily with the description given by those authors have been found at lowest intertidal levels at Solromar, Ventura Co., 11/17/56, *15331*.

Iridaea splendens (Setch. & Gard.) Papenfuss

This plant was described from Carmel, California, as *Iridophycus splendens* Setchell & Gardner 1937b:170, is well known in the Monterey region, and has been reported from Cape Kiawandi,

Oregon. A "southern California" distribution in the original description was not supported by cited specimens. The present collection, *16600*, was from lowest intertidal levels at Government Point, Santa Barbara Co., 5/16/57.

Botryocladia neushulii sp. nov.

Plate 21, Figs. 6-8. Plate 23, Fig. 10.

Thalli 8-20 (32) cm. altitudine ex axibus uno vel pluribus, e superficie disci basalis ampli vel patellae orientibus, constantes; axes erecti solidi, cylindrici, plerumque 1.5-2.0 mm. diametro, parce irregulariter ramosi, ramis vesicularibus multifariis cavis parvis sparsis irregulariter dispositis superiore in parte praediti, parte inferiore (6-7 cm.) axium solidorum plerumque nuda; vesiculae ovatae ad longe ellipticas, plerumque 2-3 mm. longitudine, (interdum, autem, ad 5 mm. longitudine) breviter pedicellatae, plerumque solitariae; membrana vesiculae e strato uno cellularum parvarum atque strato uno cellularum magnarum constans; glandicellulae variantes, plerumque solitariae, saepe, autem, compositae; cystocarpi ca. 750 μ diam., plerumque duo in vesicula, a membrana partim eminentes.

Thalli 8-20 (32) cm. tall, consisting of one to many erect axes arising from the surface of an extensive basal disc or plate; erect axes solid, cylindrical, mostly 1.5-2.0 mm. in diameter, distantly irregularly branched, provided in the upper parts with rather sparse, irregularly spaced, small hollow, multifarious vesicuar branches, the lower 6-7 cm. of the solid axes usually bare; vesicles ovoid to long elliptical, commonly 2-3 mm. long, but up to 4-5-5.0 mm. long, short-pedicellate, usually solitary, but often two or more grouped together; vesicle wall consisting of a single layer of small cells on the outside, and usually a single layer of much larger cells on the inside; gland cells varied, usually solitary, but frequenty compound and consisting of a base cell with one or more branch cells; cystocarps about 750 μ in diameter, usually two borne irregularly and partially projecting from the wall of the vesicle, distorting the ovoid vesicular form; antheridia and tetrasporangia not seen.

TYPE: *Michael Neushul 11/11/56*, at a depth of 50 feet in the kelp bed off Alligator Head, La Jolla, California, preserved in liquid in the herbarium of the Hancock Foundation.

Additional material: *16924*, at a depth of 30-40 feet off the north end of Neptune Place, La Jolla, 6/1/57; *9690*, in drift along shore 1 mile inside the end of San Quintín peninsula, Bahía San Quintín, Baja California, Mexico, 4/14/51; Mary Snyder, n.n. or date, La Jolla, California, Scripps Institution herbarium number

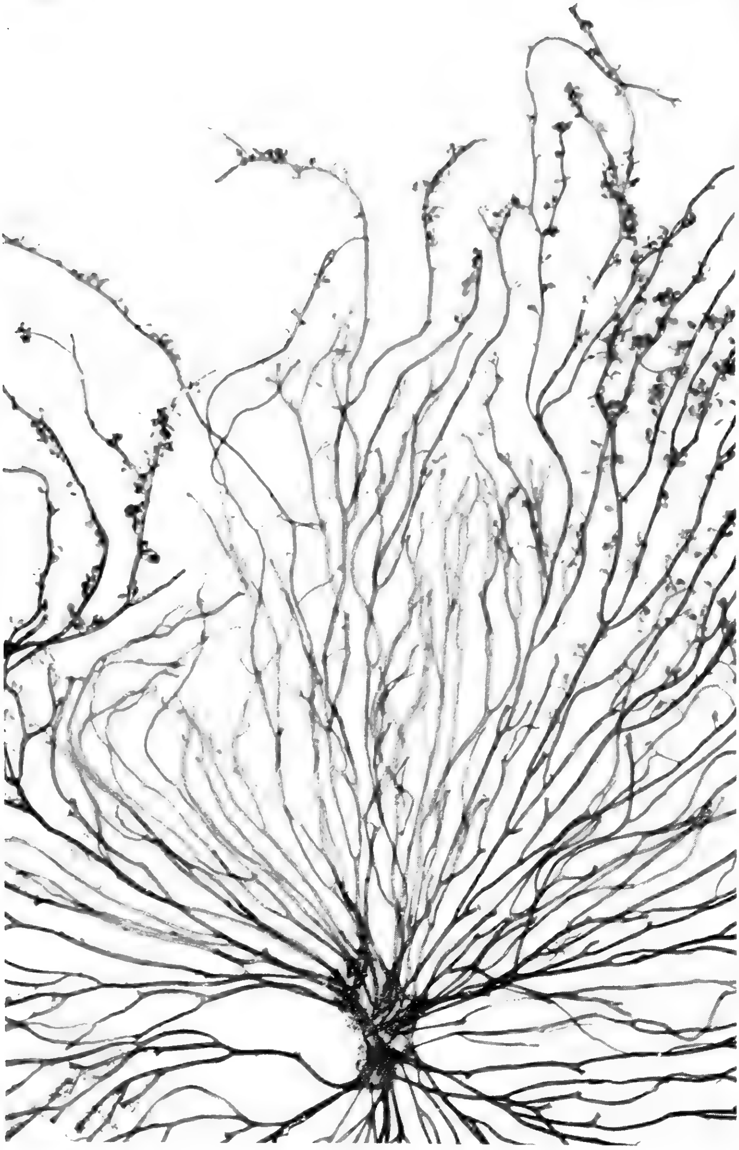

PLATE 23

Figure 10. *Botryocladia neushulii* sp. nov. A plant of the Snyder collection from drift at La Jolla, X 0.8.

140; *Neushul 4/29/57,* Malibu, sublittoral; *Neushul 4/29/57,* Sequit Point, sublittoral; *17431,* in drift, Goleta Point, Santa Barbara County, California, 10/23/57. This latter collection differs somewhat from the type in having elongated vesicles and in having gland cells quite regularly in pairs, usually from a base cell.

This species resembles some forms of *Botryocladia leptopoda* (J. Ag.) Kylin, but seems to be amply distinct in several ways. The consistently small size of the vesicles is distinctive, their irregular, scattered arrangement, and especially the way in which they are virtually absent from the lower parts of the axes within 6-7 cm. of the base. The gland cells are peculiar in their tendency to branch (Fig. 6-8), although they are somewhat variable in form and number. The plant is apparently an inhabitant of the sublittoral at depths of 30 feet or more along California and northern Baja California.

Myriogramme hollenbergii Kylin

This species has been reported only from two widely separated localities, namely, Monterey, California, and Isla Magdalena, Baja California, Mexico. The present collection, *16890,* obtained from a *Laminaria* holdfast collected by Mr. Neushul at a depth of 30-40 feet off south La Jolla, June 1, 1957, is from about half way between the two earlier stations.

Erythroglossum californicum (J. Ag.) J. Ag.

A southward extension of known distribution from Santa Barbara is represented by *15784* from Ventura, California, 12/10/56.

Rhodomela larix (Turner) C. Ag.

Like *Fucus gardneri,* this species has been widely known from Alaska to San Luis Obispo Co., California. The present collection probably represents its southern limit: *16591,* Government Point, 5/16/57.

Laurencia lajolla sp. nov.

Plate 24, Fig. 12

Thalli conferte fasciculati ad caespitideos cum aliis algis humilibus, 2-3 cm. altitudine, constantes ex axibus pluribus erectis cylindricis ramosis, e systemate complicato ramorum basalium repentium implicatorum orientibus; axes erecti 700-850 μ diametro, longos ramos sparsos, atque in partibus superioribus breves ramos frequentes plus minusque determinatos habentes; cellulae superficiales in vallo non ordinatae, in cacuminibus non eminentes; cellulae medullares sine incrassationibus lenticularibus; tetrasporangia in brevibus ramis simplicibus lateralibus sine modificatione orientea.

Thalli densely clumping to turf-forming with other low algae, 2-3 cm. tall, consisting of many, erect, branched cylindrical axes

from a complex system of creeping, entangling basal branches attached by irregular discs at many points; erect axes sparsely long-branched with frequent short, more or less determinate branches in the upper parts, 700-850 μ in diameter; surface cells not arranged in a palisade, not projecting at the tips; medullary cells without lenticular thickenings; tetrasporangia borne in simple lateral short-branches, without modification.

Type: *Dawson 17056*, growing as part of a coralline turf on the reef flat below the north end of Neptune Place, La Jolla, California, June 1, 1957.

Another collection may be referred here with uncertainty, *15619*, Corona del Mar, 12/2/56. The material is short, about 1 cm. tall, and apparently immature, but in habit and aspect is like this species.

This is the first turf forming *Laurencia* to be described from southern California. It is much smaller in all respects than the northern *L. crispa*, and does not correspond with any of the small species in the section Cartilagineae as monographed by Yamada (1931).

It is puzzling to find this plant growing abundantly in an area that was quite intensively collected by the writer 12-15 years ago, especially for laurenciae. It is apparent that a considerable change in the composition and quality of the vegetation of some of the La Jolla localities has taken place during this interval of time, and that this species is one that either was grossly overlooked, or has become well established where it was rare or absent before. The immature winter collection from Corona del Mar suggests that this species may also be common and mature there in summer.

Chondria pacifica Setch. & Gard.

This plant has been reported from Carpinteria and La Jolla, California, and from Cabo Colnett and Isla Cedros, Baja California, Mexico. It now appears to be of occasional occurrence in a number of localities along southern California and to extend north almost to Point Conception: *15287*, Topanga Canyon, 11/16/56; *17389*, Arroyo Sequit, 11/18/56; *16105*, Arroyo Hondo, 2/11/57.

Chondria decipiens Kylin

Kylin described and illustrated this species from large, lax material collected at Monterey, California. Kylin pointed out that Harvey (1853) had known the plant but had not described it. Smith (1944) reported it as known only from Santa Cruz and from Monterey. Dawson (1945) reported it from La Jolla, and (1949) from Cabo Colnett, Baja California, but the plant has remained ill understood. The present collections include a number of small *Chondria* examples which did not at first suggest the large, lax form of *C. decipiens* previously known to me, and, accordingly, I searched the literature for other possible identifica-

tions. This led to the description of *Chondria cornuta* Börgesen (1932) from Bombay, India and to comparison with one of Bör-

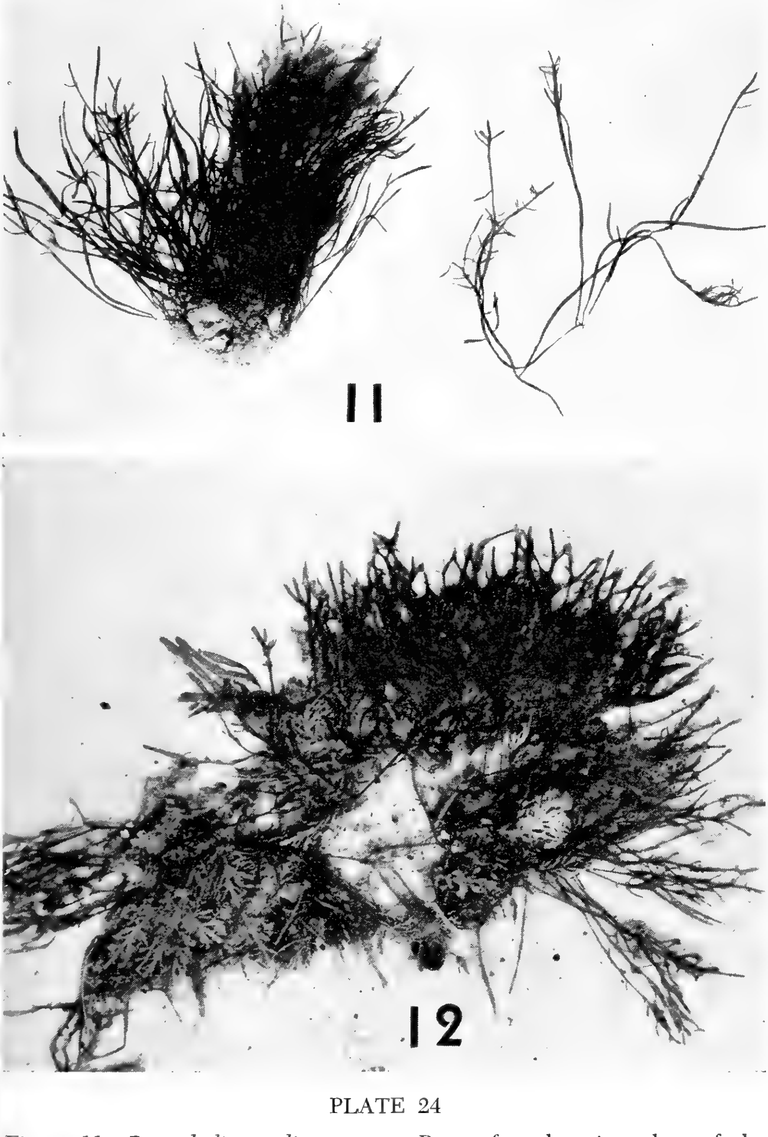

PLATE 24

Figure 11. *Pterocladia media* sp. nov. Parts of a clumping plant of the type collection, X 1.4. Figure 12. *Laurencia lajolla* sp. nov. A part of a turf mixed with *Corallina*, from the type collection, X 1.4.

gesen's specimens which is remarkably similar in a number of characters (particularly in the presence of the spine at the base of the cystocarp) to some of the shorter, non-fasciculately branched California specimens.

The subsequent collection of material at different seasons in southern California revealed a range of size and habit which pointed to identity with Kylin's *C. decipiens*, but a detailed comparison of more ample and fully developed material of Börgesen's older Indian species remains to be made in order to establish real differences if any. Meanwhile, *Chondria decipiens* Kylin may be recorded from the following localities: *15326, 15360*, Solromar, West Malibu, 11/17/56; *15700, 15711*, Point Dume Bay, 12/15/56; *15765, 15767, 15770*, Ventura, 12/16/56, abundant!; *17295*, Ventura, 7/28/57; *15921*, Carpinteria, 1/3/57; *16106*, Arroyo Hondo, 2/11/57; *16371*, Lechuza Point, 3/14/57; Santa Barbara Point, 4/10/57; *16529*, Goleta Point, 4/12/57.

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THE EARLY STAGES OF ONCOCNEMIS PERSCRIPTA (GUENEE)

(Lepidoptera: Phalaenidae)

By JOHN ADAMS COMSTOCK

The dun little moth, heretofore listed as *Lepipolys perscripta,* is a widey distributed species, occurring from Massachusetts to Florida, and westward through Colorado to California.

It is not a common species, its occurrence being local and sporadic, probably as a result of its being restricted in its food plants to certain members of the Figwort family.

The imago is pictured in Holland's "Moth Book",[1] Plate XXI, figure 11.

Recently (1954)[2] Dr. W. T. M. Forbes placed it in the genus Oncocnemis.

The mature larva was first described by Harrison G. Dyar in 1903[3] from Florida examples, received from Seifert, who reported the food plant as *Linaria canadensis* Dum. (Toad Flax).

We first observed this larva in June of 1957, feeding on *Antirrhinum nuttallianum* Benth., in Del Mar, California. Examples were raised to maturity, the first imago emerging March 30, 1958. Shortly thereafter two females emerged, from which we secured a few infertile eggs.

This year (1958) the food plant was abundant, owing to the copious spring rains, and scores of larvae were found through April and May.

This made possible the recording of the following notes on the life history:

Oncocnemis perscripta (Guenee)

EGG: Hemispherical; average width .65 mm.; height .6 mm. The top is regularly rounded and the base gently convex. Micropyle, small and depressed.

The surface is covered by prominent ridges running from base to micropyle, several of which become confluent with others, or are discontinuous near the upper and lower areas of the egg. The outer edges of these ridges show a slight tendency to be studded with nodules. The depressions or troughs between the ridges are not crossed horizontally by lines or grills.

There are approximately 35 to 40 of the vertical ridges.

The color of the egg is a glistening yellow. See Plate 25, fig. 1.

In the earlier instars, the head is ivory white, and the body predominantly light gray-green, with only faint suggestions of the

[1]The Moth Book, W. J. Holland, Doubleday, Page; 1908.

[2]Lepid. of New York and Neighboring States, Cornell Univ. Agr. Exper. Sta. Memoir 329. 111; 125, 1954.

[3]Proc. Ent. Soc. Wash. 5: 292, 1903.

longitudinal bands that are characteristic of the last two instars. In a few examples, this light coloration persists up to the penultimate instar, but the majority change to the striking and boldly contrasting colors and patterns as hereafter recorded for the mature larva.

Mature Larva: Length, 39 mm. Greatest width, 4.5 mm. Cylindrical, the head narrower than the first two thoracic segments. The caudal segments show a very slight suggestion of a 'hump'.

Head. Width, 2.75 mm. Ground color, white, covered with numerous black spots, most of which are round, though a few are quadrate or irregularly elongate. Most of the spots carry black setae. Mouth parts white, except for the brown-tipped mandibles. Antennae, white on proximal segments, ringed with black on distal segments. Ocelli, black.

Body. Ground color predominantly black on the dorsum and lateral surfaces, and gray on the venter. Strongly contrasting with this is the middorsal band of bright yellow spots on a white base running longitudinally, and the somewhat similar stigmatal band.

The middorsal band is composed of two spots to each segment, the anterior spot being triangulate, with a white bar crossing it transversely, and a round black spot at each end. The posterior spot is oval, on each side of which is a white circle with a round black center.

The middorsal band is lacking on the first two thoracic segments, the ground color of which is white. Several round black spots are superimposed on this. The last two caudal segments are also white with black spots.

The broad stigmatal band is white, with spots and streaks of yellow running irregularly along it. Numerous black spots or papillae are superimposed on it. The placement of these spots on each segment is shown in our illustration, Plate 25, fig. 2. This stigmatal band is interrupted on each segmental juncture by a narrow black stripe.

There is a poorly defined and irregular third row of yellow spots running substigmatally, which tend to obsolescence on the caudal segments.

The legs are white, with numerous small black spots, and brown tips.

The prolegs and anal prolegs are white, with a slight tinge of yellow, and bear small black spots. The crochets are black, as are also the spiracles.

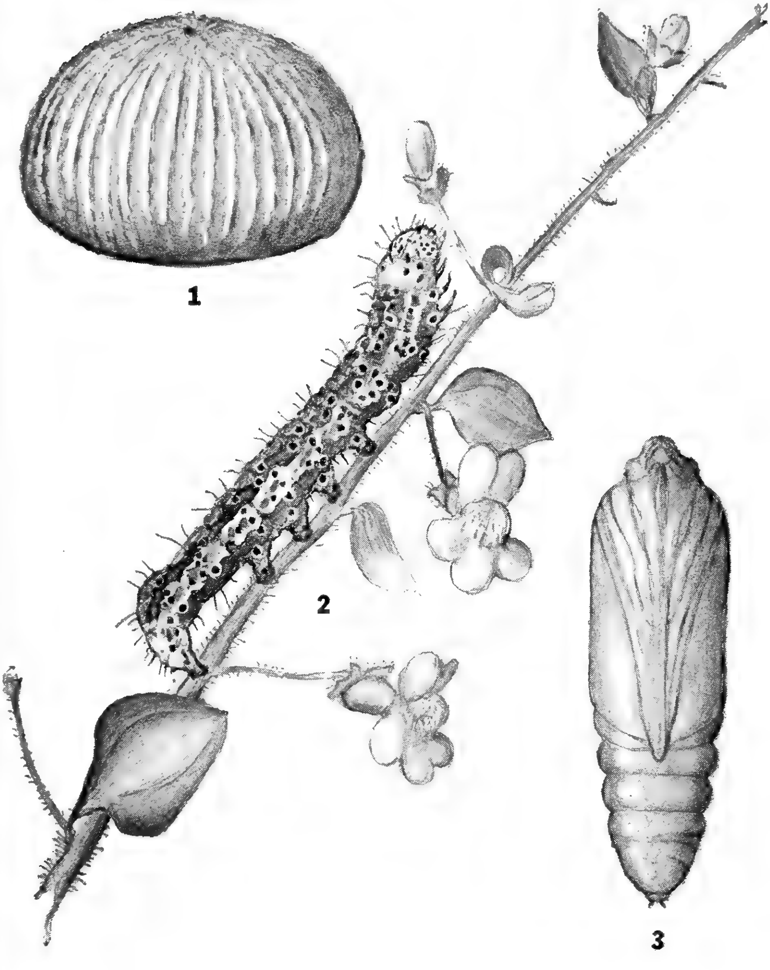

PLATE 25

Egg, larva and pupa of *Oncocnemis perscripta* Guenee.

Figure 1. Egg, viewed from the side and slightly tipped forward to show the micropyle. Enlarged X 70.

Figure 2. Larva, lateral aspect, feeding on a sprig of *Antirrhinum nuttallianum.* Enlarged X approximately 1¾.

Figure 3. Pupa, ventral aspect, enlarged X approx. 3⅓.

Reproduced from painting by the author.

Pupation occurs under the soil, in a thin oval cocoon, covered externally with granules of sand.

It is worthy of note that in the descriptions of the larvae by both Forbes and Dyar (l. c.) no mention is made of a yellow coloration superimposed on the white bands. With all of the larvae observed by us, this yellow was a conspicuous feature.

Pupa: Average length, 18 mm. Greatest width through shoulders, 5 mm. Fusiform, with regularly rounded head, and slightly protruding eyes. The ground color is a soft tan, on which is superimposed a faint whitish bloom, and with slightly darker shading on the segmental lines, head and cremaster.

The maxillae extend a short distance beyond the wing margins, and the antennae terminate about .7 mm. short thereof. The spiracles are dark brown, transversely elongate-oval, and slightly convex. The cremaster ends in a pair of very short simple spines. See Plate 25, fig. 3.

No attempt has been made to accurately map the position of the diagnostic setae on the segments, but preserved larvae will be placed with the Division of Entomology, U. S. National Museum, the Gibbs Research Laboratories of Yale University, and with S. E. Crumb of Puyallup, Washington, in order that specialists may have them available for future study.

O. perscripta is an early flyer, and is apparently single brooded in southern California.

The only other lepidopterous larva found in association with it on the *Antirrhinum* was a single example of *Junonia coenia* Hbn.

Two species of parasites were recovered from the *perscripta* larvae.

A REMARKABLE NEW GENUS OF COROPHIID AMPHIPOD FROM COASTAL MARINE BOTTOMS OF SOUTHERN CALIFORNIA*

By J. LAURENS BARNARD

A survey of marine muddy bottoms of southern California has revealed a host of new crustacean species, one of which is described below (see Hartman, 1955, for techniques and Hartman and Barnard, 1957, for station data).

This unusual amphipod is noted for its long eye lobes which give it a shrimp-like appearance. The animal belongs to a family of which many members build tubes into which they nestle. The tubes are usually attached to firm objects such as rocks or algae.

From its distribution, morphology and color, it is presumed that this species builds its tubes on small pebbles or red algae and that it emerges to feed on the algae or associated detritus. The projecting eye lobes and feeble antennae would seem to increase its ability to detect predators or varying light values without protruding much of its body from the tube.

The new genus and species is of interest because it is the only abundant member of the family Corophiidae in subtidal waters of southern California. The familiar genus *Corophium* (see Barnard, 1958) is abundant in harbors and estuaries of southern California, in seas such as the Baltic and intertidal regions of many other areas but is poorly represented on open ocean bottoms of southern California (based on analysis of more than 600 quantitative samples). However, this new corophiid apparently has its southern limit of distribution in southern California. It is found occasionally along the coast between Pt. Conception and Pt. Mugu (Plate 28) but has not been collected south and east of Pt. Mugu to the Mexican border (400 samples examined).

The species shows no depth or temperature submergence to the south (samples up to 200 fms have been examined), presumably because of its dependence on a shallower red algal association. It would be of interest to examine known areas of cold water upwelling along the shores of Lower California (Dawson, 1951) to check for a discontinuous distribution dependent on temperature.

SYSTEMATICS

Due to the number of new corophiid genera described since the treatise of Stebbing (1906) it has been necessary to construct a new key to the genera, which follows. References to the genera

*Contribution No. 221 from the Allan Hancock Foundation, University of Southern California.

and their species may be obtained in my "Index to the . . . Gammaridea" (Barnard, 1958a).

KEY TO THE GENERA OF THE COROPHIIDAE

1.	Uropod 3 lacks rami	CONCHOLESTES
1.	Uropod 3 bears 1-2 rami	2
2.	Mandibular palp 3-jointed	3
2.	Mandibular palp less than 3-jointed	14
3.	Uropod 3, inner ramus distinct	4
3.	Uropod 3, inner ramus absent or indistinct	5
4.	Coxae in continuity	PARACOROPHIUM
4.	Coxae not in continuity	CAMACHO
5.	Uropod 2 with one ramus	6
5.	Uropod 2 with two rami	7
6.	Gnathopod 2 in male, not gnathopod 1, complexly subchelate	CERAPUS
6.	Gnathopod 1 in male, not gnathopod 2, complexly subchelate	CHEVREUXIUS
7.	Antenna 1 lacks accessory flagellum	8
7.	Antenna 1 bears accessory flagellum	11
8.	Male gnathopod 2 complexly subchelate	ERICTHONIUS
8.	Male gnathopod 2 not complexly subchelate	9
9.	Pleon segments 5-6 fused	KAMAKA
9.	Pleon segments 5-6 separate	10
10.	Male gnathopod 2 chelate, coxae short	CERAPOPSIS
10.	Male gnathopod 2 subchelate, coxae long	GAVIOTA n. gen.
11.	Male gnathopod 1 complexly subchelate	GRANDIDIERELLA
11.	Male gnathopod 1 simply subchelate	12
12.	Male antenna 2, articles 3-5 stout, uropod 3 with prolonged peduncle	UNCIOLA
12.	Male antenna 2, articles 3-5 slender, uropod 3 with symmetrical peduncle	13
13.	Antenna 2 much shorter than 1, pleon segments 4-6 tall	UNCIOLELLA
13.	Antenna 2 longer than 1, pleon segments 4-6 very depressed	NEOHELA
14.	Mandibular palp 1-jointed	SIPHONOECETES
14.	Mandibular palp 2-jointed	COROPHIUM

Notes:

Unciola crassipes Hansen is aberrant for its biramous third uropod (see Stephensen, 1944).

Pseudericthonius Schellenberg (1926): the male is unknown; the female is distinguished from other genera in the family by the short inner rami of uropods 1 and 2.

Parunciola Chevreux (1911): the male is unknown; the genus has a place in the key starting with couplet 11; it is distinct for its long peduncles and short flagella of antennae 1 and 2.

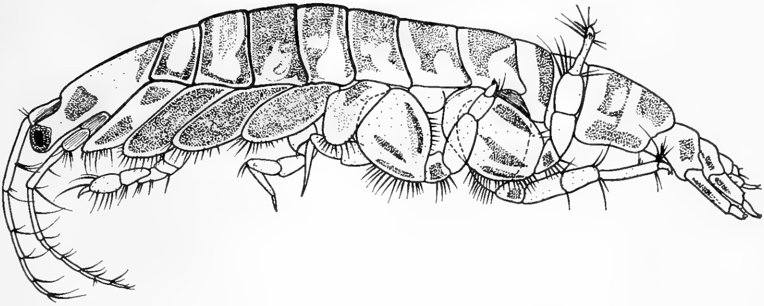

PLATE 26

Gaviota podophthalma n.g. n. sp. Holotype, female, 4.5 mm, sta. 4845, lateral view.

Gaviota, new genus

DIAGNOSIS.—Uropod 3 uniramous, mandibular palp triarticulate, antenna 1 lacks accessory flagellum, antenna 2 slender, gnathopods 1 and 2 of both sexes similar in size and subchelate (gnathopod 2 is slightly larger), urosome segments 1-3 each distinct, uropods 1 and 2 biramous, the rami of equal length, coxae contiguous and large, eyes borne on long projections of the head.

TYPE SPECIES.—*Gaviota podophthalma,* n. sp.

RELATIONSHIPS.—The genus *Gaviota* resembles *Kamaka* Derjavin (1923) more than any other genus in the family due to the projecting eye lobes which *Kamaka* bears in a lesser degree. The lack of sexual differences in the gnathopods and the distinct segments of the urosome distinguish *Gaviota* from *Kamaka.* (See Gurjanova, 1951, for a review of *Kamaka,* which is composed of three species in the northwestern Pacific.)

Gaviota podophthalma, new species

(Plates 26 and 27)

DESCRIPTIVE FEATURES.—The drawings of the species are diagnostic and more or less self-explanatory but several points need emphasizing: (1) the first coxa is as long as the second but more

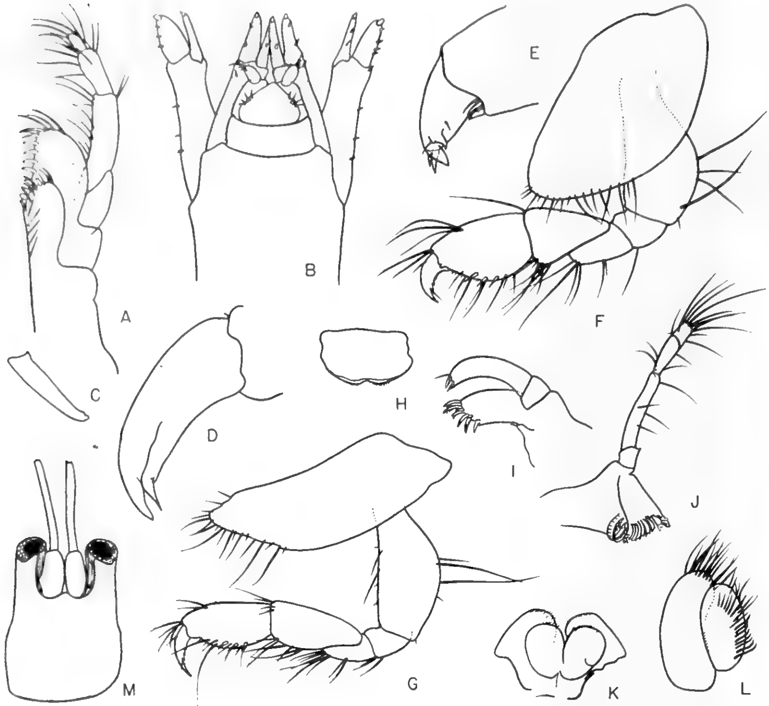

PLATE 27

Gaviota podophthalma n.g. n. sp. Paratype, female, 4.5 mm, sta. 4845. Figs. A, maxilliped; B, urosome, dorsal; C, article 7, peraeopod 1; D, article 7 of peraeopods 4 (and 5); E, article 7 and part of 6 of peraeopod 3; F, G, gnathopods 2, 1; H, upper lip; I, maxilla 1; J, mandible; K, lower lip; L, maxilla 2; M, head, dorsal.

slender, while in *Kamaka* the first coxa is very broad and plate-like; (2) the seventh articles (dactyli) of the peraeopods are unusual and contrast with the long slender ones of *Kamaka;* (3) the apices of the mandibular and maxillipedal palps as well as the eye lobes and mandibular lobes of the lower lip are blunter in *Gaviota;* (4) the lower anterior corner of the head is not produced in *Gaviota.*

Careful identification of the male and female of the species has been made, the male bearing genital papillae on the ventrum of segment 7.

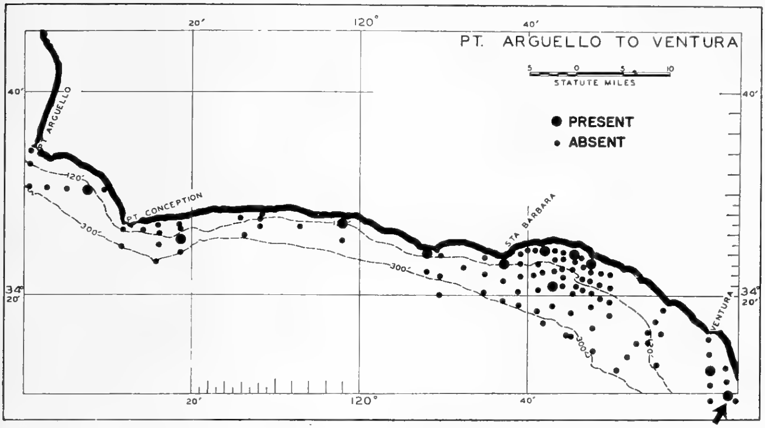

PLATE 28

Map showing distribution of *Gaviota podophthalma.* The arrow indicates the type locality.

Color.—In formalin, heavily pigmented in a purplish brown according to the pattern shown for the lateral view of the animal.

Holotype.—AHF No. 571, female, 4.5 mm.

Type locality.—Station 4845, 3.25 mi 240° T from Port Hueneme Light, California, 34-07-00 N, 119-16-05 W, 39 ft, olive green sand, Feb. 7, 1957, collected with an orange-peel-grab.

Material examined.—(listed in order of west to east, shallow to deep, (according to map) Stations 4817 (14), 5561 (3), 4823 (14), 5161 (6), 5566 (1) (= same position as 5161), 4953 (2), 4825 (1), 5270 (3), 5581 (1), 5177 (4), 4839 (12), 4845 (30).

Distribution.—Pt. Arguello to Pt. Mugu, California, 39 to 190 feet (12 to 58 meters).

I am indebted to Mr. Gilbert F. Jones for his aid with this project.

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NOTES ON AN UNEXPECTED ASSOCIATION BETWEEN A COMMON BARNACLE AND ECHINOID

By RICHARD A. BOOLOOTIAN
University of California at Los Angeles

Echinoids may serve as hosts to a variety of symbionts despite an armature of spines and pedicellariae. Various arthropods have been taken in association with echinoids. An ostracod was found on the anal spines of *Strongylocentrotus dröbachiensis* (Lönneberg, 1898). Brattström (1936) reported that *Echinocardium cordatum* may be badly infested with a barnacle, *Ulophysena öresundense*. However, this barnacle, which resembles a sac, is attached to the inner surface of the test with an opening to the exterior through which the cypris larvae escape. The spines of cidaroids, being devoid of a living epithelial lining, occasionally

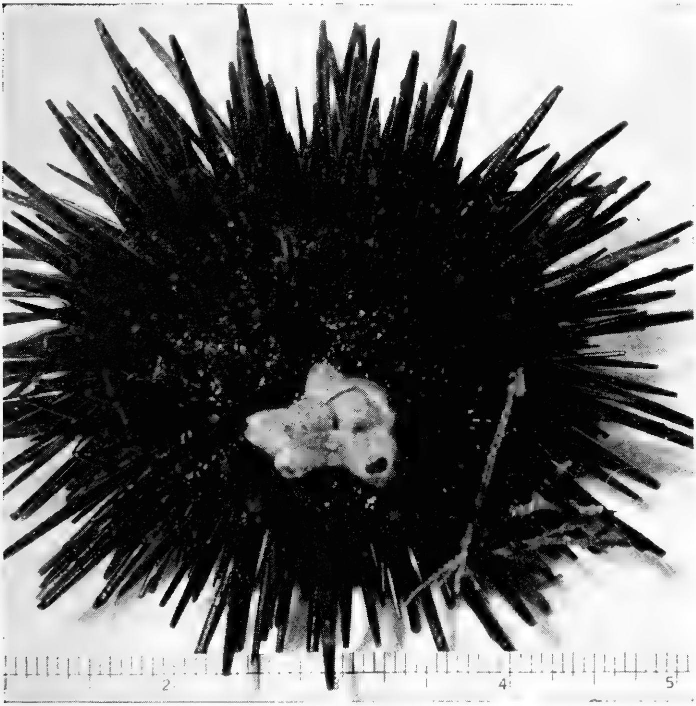

PLATE 29

Aboral view of *Strongylocentrotus franciscanus*, showing position occupied by barnacle, *Balanus tintinabulum*. Scale in inches.

are found overgrown wtih a variety of sessile organism, including algae, sponges, hydroids, bryozoans, anemones, tubiculous polychaetes, and barnacles according to Hyman (1955). However, Hyman makes no mention of sessile organisms living directly on or attached to the outer surface of the rigid globiferous test.

Specimens of *Strongylocentrotus franciscanus* collected from Malibu, California, by Mr. R. C. Fay, graduate student at the University of California at Los Angeles, included one with a single, relatively large barnacle, *Balanus tintinabulum,* attached directly to the test, and smaller barnacles of the same species attached to the larger one. The basis of the barnacle measured 15.6 mm. and is positioned off-center from the oral-aboral axis, partly on the ambulacral and partly on the interambulacral plates. Primary and secondary spines with their complement of pedicellariae nearest the barnacle are normal with respect to length and numbers. The other attached barnacles range in diameter of basis from 4.2 to 10.4 mm.

The main barnacle is oriented with the rostrum proximal the madreporite and with the occludent margin of the scutum forming an angle of 125° with the ambulacral tube feet. No anomolies were noted on the inner surface of the urchin's test. However, there is some discoloration and a reduction in size of the ampullae in this part of the test. The suture between the ambulacral and interambulacral plates is widely separated.

Pedicellariae are generally presumed to keep the test clear of detritus and foreign objects, and perhaps to catch small animals as food. Their efficiency in maintaining the clean surface of echinoids is readily appreciated by an observation of the massed colonies of these animals in the lower intertidal and subtidal regions. It is therefore interesting to speculate on the origin of this unusual exception. Perhaps a mechanical blow sufficiently damaged the test to inflict a local injury. This may have removed a small cluster of spines and pedicellariae and provided a cypris larva an available substrate.

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DESCRIPTION OF A NEW ISOPOD FROM CALIFORNIA, EXOSPHAEROMA INORNATA[1]

By THOMAS G. DOW

INTRODUCTION

The specimens examined in this study were collected by Dr. John L. Mohr, along the California coast at Palos Verdes, Los Angeles County. Several hundreds of the animals were found. The assistance of Dr. Robert J. Menzies in the preparation of this article is sincerely appreciated.

ORDER - FLABELLIFERA
FAMILY - SPHAEROMIDAE
Exosphaeroma inornata n. sp.

DIAGNOSIS: First antenna with 13 segments, second with 17. Rostrum of cephalon touching clypeus in midline. Maxillipedal palp with 5 articles; middle three produced medially into lobes. Peraeonal somites smooth, pleon smooth. Peraeopods all ambulatory, with small dactyli. Apex of pleotelson truncated, with minute marginal setae. Appendix masculinum of male extending beyond margin of pleopod, apex smooth and pointed. Exopod of uropod shorter than endopod by ¼ of its length.

DESCRIPTION:

CEPHALON: Rather small in comparison with body, eyes lateral. Front with pointed rostrum touching clypeus in midline.

FIRST ANTENNA: Composed of 13 articles; first twice the length of the second; the narrower third subequal to the first, and twice the length of the remaining segments.

SECOND ANTENNA: with 17 articles; the first three subequal and half the length of the fourth and fifth. The fifth three times the length of the narrower sixth.

MANDIBLES: Right and left similar, except that left has a lacinia mobilis with two teeth. This is lacking from right. Incisor slightly pigmented, right and left with four stout teeth. About twelve smaller teeth and setae on setal row, which extends out some distance from the mandible. Protruded, cup-shaped molar, containing about 50 stout setae. Palp with three articles, outer two setiferous.

FIRST MAXILLA: Bi-lobed; inner lobe with 9 setae, outer with 5, four of which are larger than the fifth and are plumose.

1Contribution No. 303 Lamont Geological Observatory; Biology Program No. 24.

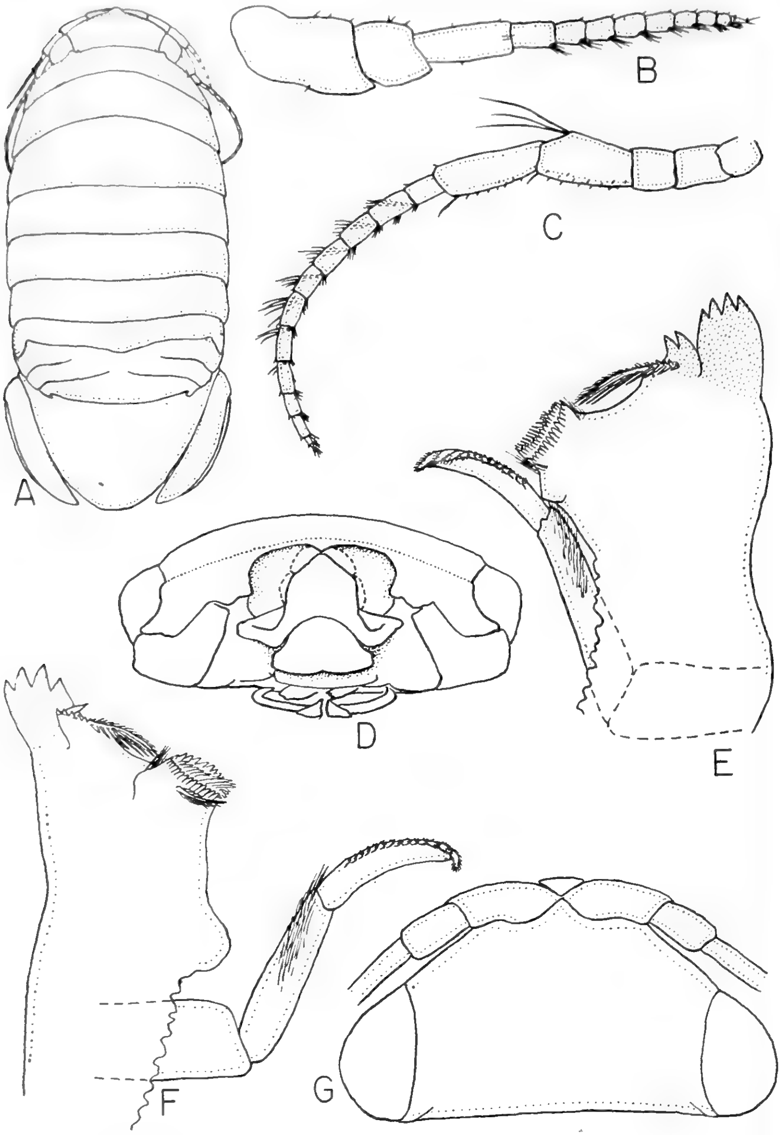

PLATE 30

Exosphaeroma inornata n. sp.; A, adult male; B, first antenna; C, second antenna; D, front of cephalon; E, left mandible; F, right mandible; G, top of cephalon.

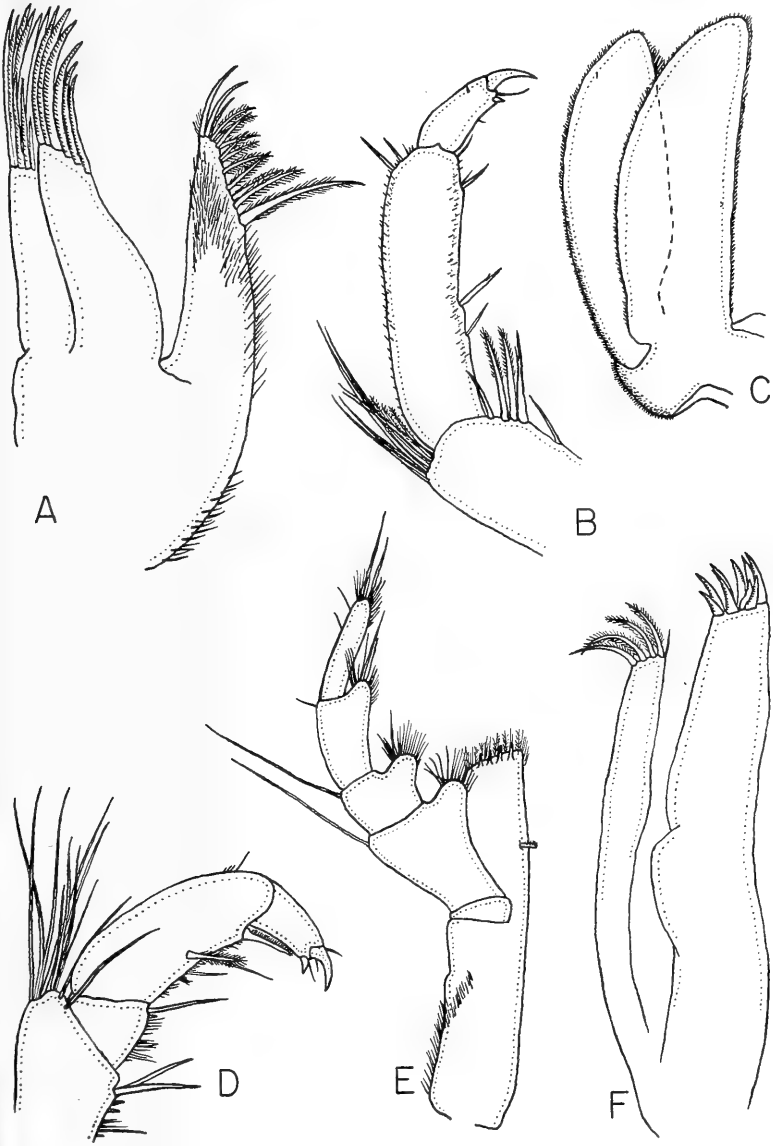

PLATE 31

Exosphaeroma inornata n. sp.: A, second maxilla; B, outer articles of seventh peraeopod; C, uropod; D, outer articles of first peraeopod; E, maxilliped; F, first maxilla.

SECOND MAXILLA: Tri-lobed; outer lobe with 9 setae, middle with 6, inner with 14.

MAXILLIPED: Palp composed of 5 setiferous articles; the middle three are produced into lobes, Sympod with 4 stout setae on end, in addition to many small setae.

PERAEON: Coxal plates present on all somites except first; in dorsal view they are folded under and are inconspicuous. All somites smooth.

PERAEOPODS: First leg half the length of the seventh. All terminated by small curved dactyli, all ambulatory.

PLEON: With 3 distinct segments including pleotelson. Middle segment broad, with two suture lines. Pleotelson convex and smooth. Apex of pleotelson truncated, with minute setae along margin.

PLEOPODS: Endopod of first pleopod with 19 plumose marginal setae, exopod with 39. Endopod of second pleopod with 17 setae, exopod with 42. Endopod of third with 17 setae, exopod with 37. Exopod of fourth with 3 plumose apical setae, both endopod and exopod with small marginal setae. Fifth pleopod also with numerous small setae, plus two apical setiferous lobes on exopod. Appendix masculinum of second pleopod of male pointed and extending beyond margin of pleopod; apex without setae or teeth.

UROPOD: Exopod shorter than endopod by ¼ of its length. Both rami with minute marginal setae.

MEASUREMENTS: Holotype, male, 5.2 mm in length, 1.4 mm wide; allotype, female, 5.3 mm in length, 1.4 mm wide; paratypes ranging in length from 2.5 mm to 6.0 mm.

ECOLOGY: Found under holdfasts of kelp *(Macrocystis)*.

TYPE LOCALITY AND TYPES: A series of 232 paratypes has been examined. These, with the holotype and allotype, have been sent to the Southern California Academy of Science for deposit in the Los Angeles County Museum.

AFFINITIES: *Exosphaeroma inornata* most closely resembles *Exosphaeroma octoncum* Richardson and *E. crenulatum* Richardson as described in Richardson (1905). *E. inornata* differs from *E. octoncum* in having no tubercles on the pleotelson, which is also less convex than in *E. octoncum*. The lobes of the three middle articles of the maxillipedal palp of *E. inornata* are considerably more pronounced than in *E. crenulatum* and the exopod of the uropod of *E. inornata* is not crenulated as in *E. crenulatum*.

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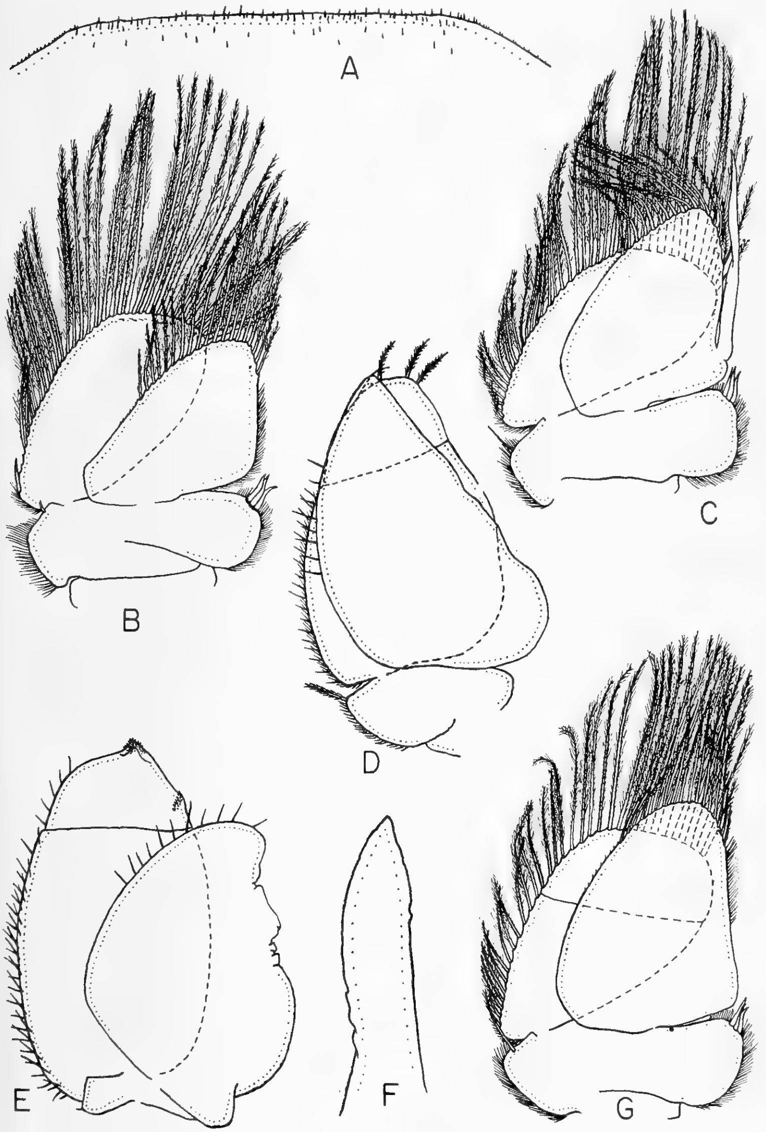


PLATE 32

Exosphaeroma inornata n. sp.: A, apical margin of pleotelson; B, first pleopod; C, second pleopod; D, fourth pleopod; E, fifth pleopod; F, apex of appendix masculinum of second pleopod; G, third pleopod.

STUDIES ON THE OPISTHOBRANCHIATA: II. A New Tectibranch of the Genus Philine[1]

By N. T. Mattox

Department of Biology
University of Southern California, Los Angeles

Among the collections of the Allan Hancock Foundation, University of Southern California, are 19 lots of a tectibranch which have been collected from the coastal waters of southern California. Most of these collections are from near Santa Catalina Island, but three are from San Benito Island, off Baja California, and one collection from near San Clemente Island. A total of 164 specimens are represented in these collections. Among those collections from near Santa Catalina Island are several which were taken recently during the investigations mentioned in the first of this series of reports on opisthobranchs of this area, Mattox 1955. Careful study of these "slugs" resulted in the unquestionable decision that they represent an undescribed species of the genus *Philine.* This form is here designated as *Philine alba.*

Philine alba n. sp.

DESCRIPTION: The body form of the animal is typical of that of the suborder Cephalaspidea. The body is conspicuously divided into a large, oblong, fleshy head shield which extends posteriorly over the reflexed mantle region of the body (Fig. 1). Small, lateral epipodal folds extend dorsally between the head shield and the mantle region of the visceral hump. The posterior edge of the mantle is extended beyond the visceral hump as a short, smooth frill. The general body color of the living animal is a milky white tinted with spots of yellow-tan to pale pink. The median portion of the visceral mass is translucent through which the heart beat may be seen. Ventrally the foot is roundly truncate both anteriorly and posteriorly; it extends posteriorly only about four-fifths the body length. There are no tentacles. A pair of ridge-like rhinophores is found anteriorly on either side of the mouth in the groove between the body hump and the laterally

[1]Allan Hancock Foundation Contribution No. 215.

extended foot. The eyes are internal and usually are not visible externally as they lie covered by the anterior muscles of the head fold. The total body length of the holotype is 52.8 mm, the head fold is 38.5 mm in length and the greatest body width is 40.5 mm.

In the deep groove between the foot and the cephalic disc on the right side are found the seminal groove and the anteriorly located penis. The penis is contained in a pocket situated antero-

PLATE 33

1. Photograph of dorsal view of *Philine alba* (Holotype).
2. Photograph of the dorsal view of a series of shells of *P. alba*.
3. Photograph of the aperture view of a shell of *P. alba* (Paratype).

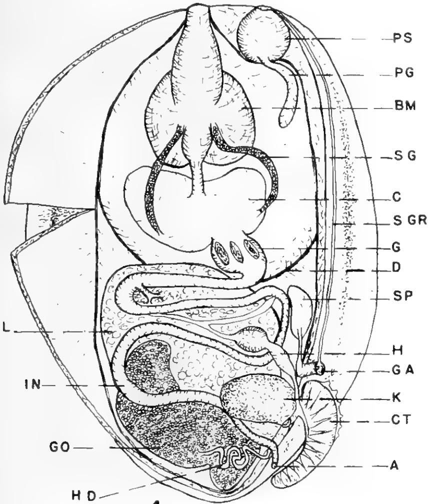
laterally below the right rhinophore. The mantle aperture is a long opening the anterior part of which opens into the groove between the epipodium and the visceral hump on the right side. The mantle cavity contains the ctenidium, the anus, renal opening and the genital aperture from which the seminal groove arises (Fig. 4).

The shell (Figs. 2 & 3) is capable of containing but a small part of the body, is entirely internal, and is covered by the reflexed and united mantle. It is white, thin, fragile, and smooth with faintly spiral striae. The outer surface is covered by a membranous periostracum. The shell is depressed, roundly ovate, one to two whorls in the small, open spire; the nucleus is covered by a shelly callus. The aperture is widely expanded anteriorly and laterally and extends into a rounded lobe above the posterior end of the spire (Fig. 3). This lobe is marked by an external elevated ridge and a groove extending from the region of the apex of the spire to the outer edge of the lobe (Fig. 2). The inner lip is very short, spread over the short pillar to the posterior callus. There is no pigmentation in the shell. There is no umbilical groove. In a paratype individual with a total body length of 50 mm the shell length is 23.3 mm with the aperture width of 20.0 mm and a dorsoventral thickness of 8.5 mm (Fig. 3).

The internal anatomy is distinctive. The perivisceral body cavity is haemocoelic in character. The cavity consists of two main divisions, anterior and posterior, with a thin muscular "diaphragm" separating them (Fig. 4). The anterior cavity, under the cephalic shield, contains the buccal mass, the salivary glands, the crop, the gizzard, the nerve collar and ganglia, and the prostate gland. The posterior cavity is almost completely filled by the visceral mass: the digestive gland, gonad, digestive tract, heart, and accessory genital structures.

The mouth is situated medianly in the groove between the foot and the cephalic disc. The mouth opens into a very conspicuous buccal complex of muscles. This complex is divided into a dorsomedian mass which contains the radula and two lateral extensions of muscles (Fig. 4).

The radular ribbon is folded on the median line, thus there are no central (rachidian) teeth. In each row of teeth there are one pair of large lateral teeth and two pairs of smaller marginal teeth (uncini); giving a radular formula of 2-1-0-1-2 (Fig. 7). In all radulae examined there are 24 rows of teeth, a total of 144 teeth in the functional radula. The base of the lateral teeth is broad and flat. The head of the tooth extends medianly as a sickle-shaped point bent inward and posteriorly; there are serrations on the median edge. The base of the lateral teeth is ap-



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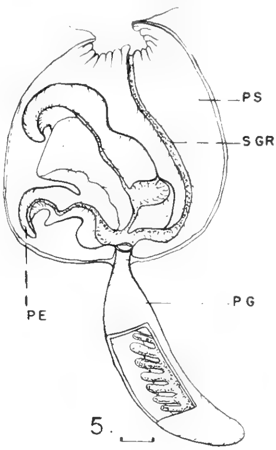

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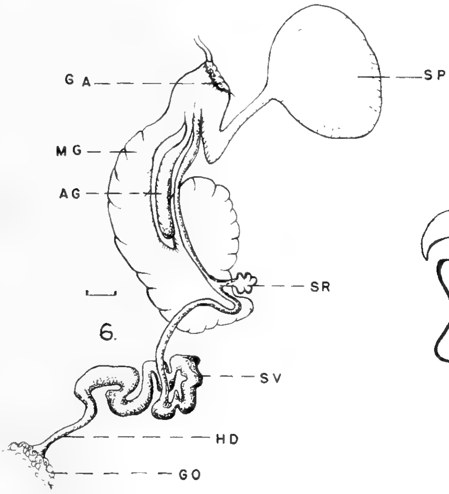

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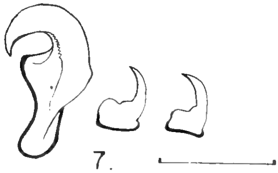

7.

PLATE 34

4. Diagram of dorsal aspect of general internal anatomy of *Philine alba* (scale equals 1 mm).

5. Diagram of the penis and prostate gland of *P. alba* (scale 1 mm).

6. Diagram of the hermaphroditic organs of *P. alba* (scale 1 mm).

7. Lateral and marginal teeth of radula of *P. alba* (scale 0.5 mm).

Symbols used: A–anus; AG–albumin gland; BM–buccal mass; C–crop; CT–ctenidium; D–diaphragm; G–gizzard; GA–genital aperture; GO–gonad; H–heart; HD–hermaphroditic duct; IN–intestine; K–kidney; L–"liver" or digestive gland; MG–mucous gland; PE–penis; PG–prostate gland; PS–penial sheath; SG–salivary gland; SGR–seminal groove; SP–spermatheca; SR–seminal receptacle; SV–seminal vesicle.

proximately 0.5 mm in width, the head of the tooth is about 0.8 mm in length. The uncini are smaller and more simple in form. The base of the uncini is approximately 0.2 mm and the slightly curved head extends about 0.3 mm from the basal portion.

The digestive tract extends posteriorly from the buccal mass as a short esophageal tube which opens into a distended crop. A pair of salivary glands extend from the dorso-posterior region of the buccal mass to the dorso-lateral walls of the crop. The crop opens into a medianly located gizzard containing three gizzard plates, one dorsal and two lateral, embedded in the wall of the gizzard. Each plate is regularly elongate and oval measuring approximately 3.6 mm by 1.7 mm. The exposed and embedded convex surfaces of the plates are marked only by inconspicuous concentric striations. Posterior to the gizzard the digestive tube passes through the diaphragm and extends, as a stomach, over the anterior surface of the digestive gland where it receives the duct of the digestive gland. The digestive tract terminates in the mantle cavity after winding through the digestive gland and passing through the posterio-lateral part of the body wall.

The gonad, an ovotestis, occupies the posterior third of the visceral mass (Fig. 4). The hermaphroditic duct arises from the dorsal surface of the posterior portion of the gonad. After passing anteriorly approximately 3 mm the duct convolutes and the walls thicken and become glandular, apparently serving as a seminal vesicle gland (Fig. 6). The hermaphroditic duct then passes laterally and enters the body wall. Within the body wall and in a ventro-lateral position the duct expands to form a small seminal receptacle before passing anteriorly to the genital vestibule inside the genital aperture. Entering the genital vestibule median and ventral to the opening of the hermaphroditic duct is a conspicuous mucous gland. Between the mucous gland and the terminal portion of the hermaphroditic duct lies an elongate, tubular albumen gland which also enters the genital vestibule. Lying in the body cavity anterior to the region of the genital aperture is the large, sac-like spermatheca connected by a tube which enters the lateral portion of the genital vestibule. Arising from the anterior edge of the genital aperture the seminal groove passes forward out of the mantle cavity into the area between the visceral hump and the right epipodium, on anteriorly between the right epipodium and the cephalic shield to the penis. The penis lies in a spherical pocket or sheath which opens externally to the right of the mouth and below the rhinophore. The penis is a T-shaped organ (Fig. 5). The seminal groove after entering the penial sheath passes to the tip of the posterior arm of the T. From the base of the penial sheath, which is embedded in the anterior body wall, the sac-like prostate gland extends into

the body cavity. The interior of the prostate gland contains a series of glandular ridges.

Philine are apparently protandric hermaphrodites. The sperm, after arising in the ovotestis, pass anteriorly out the genital aperture to the penial sheath. After receiving the secretions from the prostate the sperm are transferred by the penis into the genital aperture of another individual, thence into the spermatheca. After the termination of the sperm production period the sperm, which have been stored in the spermatheca, pass down to the seminal receptacle where they lie until needed to fertilize the eggs as they are produced and pass through the hermaphroditic duct. After fertilization the eggs receive albumen and mucous from those respective glands and are then deposited in an egg mass formed by the mucous which gels as it is extruded from the genital aperture.

The holotype, Hancock Foundation catalogue number 1030, and 17 paratypes, number 1031, were collected in 35 fathoms, 1.8 miles south-east of Long Point, Santa Catalina Island, on June 25, 1954, Velero station No. 2853-54. Other collections containing *Philine alba* were taken from 25 to 135 fathoms.

REMARKS: In 1772 Ascanius established the genus *Philine* to include the species *aperta* (Linne) as the type species by monotype. *Philine aperta*, a european species, has been the subject of study in several reports, notably by Vayssiere (1880), Guiart (1901), and Brown (1934) who gave excellent accounts of the anatomy of that species. To the best of the writer's knowledge the anatomy of other species has not been described, hence the anatomy of *P. alba* can be compared only to that of *P. aperta*.

Philine alba has a head shield which is much more extensive dorsally and is broader than that of *P. aperta*. The epipodal folds of *P. alba* are much smaller. The shell of *P. alba* is much more depressed, more circular in outline, and has a longer posterior lobe than typical *aperta*. The shell of *alba* is much larger than that of most *Philine*, a great deal larger than the only other species found in the eastern Pacific area, such as *P. californica* Willett (1944). The radula formula of *aperta* is given as 0-1-0-1-0 in contrast to 2-1-0-1-2 for *alba*. The gizzard plates of *alba* are much smaller, 3 mm, as compared to the length of 11 mm for *aperta*. The salivary glands of *aperta* are lobe-like instead of the ribbon form of *alba*. The basic plan of the hermaphroditic organs of *alba* is similar to that of *aperta* except for the very different form of the prostate gland of *alba*, sac-like in *alba* and elongate and tubular in *aperta*.

As indicated above, *P. alba* is much larger than any of the other local species known. The type specimen of *P. californica* measures 5.5 by 3.6 mm. The latticed sculpture of the shell and the broad, light-brown band across the shell makes *californica* different from *alba*. *Philine bakeri* Dall, listed from South Coronado Island, is 2 by 1.25 mm, and *P. hemphill* Dall, from off Cape San Quentin, Baja California, is 5 by 3 mm, both obviously much smaller than *Philine alba*.

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NOTES ON THE EFFECT OF PRESERVATION ON THE SEA HARE COLOR PATTERN AND THE SYNONOMY OF APLYSIA (=*TETHYS*) *RITTERI* COCKERELL

By Lindsay R. Winkler*

The pigments found in the sea hare have a varying degree of lability when subjected to preservation. As the present writer has shown (Winkler, 1958), the pigments have their source in the plant food of the sea hare. These pigment sources are of two distinct classifications: 1) degradation products of chlorophyll, and 2) the pigments peculiar to the various marine algae. The basal pigmentation shared by nearly all members of the species was shown by feeding experiments to be derived from chlorophyll. Small specimens feeding almost exclusively on the low chlorophyll-containing sea weed *Plocamium pacificum* may, however, be entirely or almost entirely pigmentless. Any pigment which may be present follows the pattern characteristics for the species and appears to be genetically controlled. This chlorophyll pigment is alcohol-fast, being permanent in the usual 70% alcoholic preservative.

The pigments peculiar to the marine algae are numerous and varyingly labile in preservatives. For example, the red streaks found on the sides of many *Aplysia californica* are derived from the pigment phycoerythrin of *Placamium pacificum,* the corallinas, and other red algae. These pigments are exceedingly labile, lasting only a few minutes in alcohol and formalin. Other green pigments are removed only after months in alcohol when the specimen reaches the state of basal pigmentation. As these factors also operate in other members of the genus, it is well to use only "cured" specimens for species study.

In 1901 Cockerell, with some hesitation, described as *Aplysia (=Tethys) ritteri* a specimen possessing very bright flame-colored markings which rapidly disappeared into the preservative. The color pattern was the only basis given for differentiating it from the common *A. californica* Cooper. The description was concluded with the statement "should any reason hereafter appear to the contrary, *T. ritteri* will at least be a very distinct variety."

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Allan Hancock Foundation Contribution No. 222.

The writer's experiments with color in *A. californica* (Winkler, 1958) would seem to obviate any direct genetic control over the color pattern produced by algal pigments other than chlorophyll. The basal pigmentation pattern, however, seems quite stable and would appear to be under genetic control. Therefore, we must accept *Aplysia (=Tethys) ritteri* Cockerell not as a distinct variety but only as a synonym of *Aplysia californica* Cooper.

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THE RANGE OF THE CALIFORNIA SEA HARE *APLYSIA CALIFORNICA* COOPER

LINDSAY R. WINKLER[1]

Allan Hancock Foundation
University of Southern California
Los Angeles, California

The range of the California sea hare, *Aplysia californica* Cooper was last reported by Burch (1945), who gave its southern limit as Todos Santos Bay, Baja, California. The writer recently studied the specimens of the Allan Hancock Collection*, University of Southern California, and is able to extend the known range of the species to more than twice that previously known. The northern limit of the species remains the same, i.e., Elkhorn slough at the end of the Monterey trench in Monterey Bay. In the protected waters of this slough it reached its largest known size of 15 pounds as reported by MacGinitie (1935). It is occasionally taken on the open coast of the Monterey area. The majority of reports, however, are south of Point Arguello.

Collections by the various Hancock expeditions into the Gulf of California have produced authentic specimens as far south as

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*Allan Hancock Foundation Contribution Number 223.

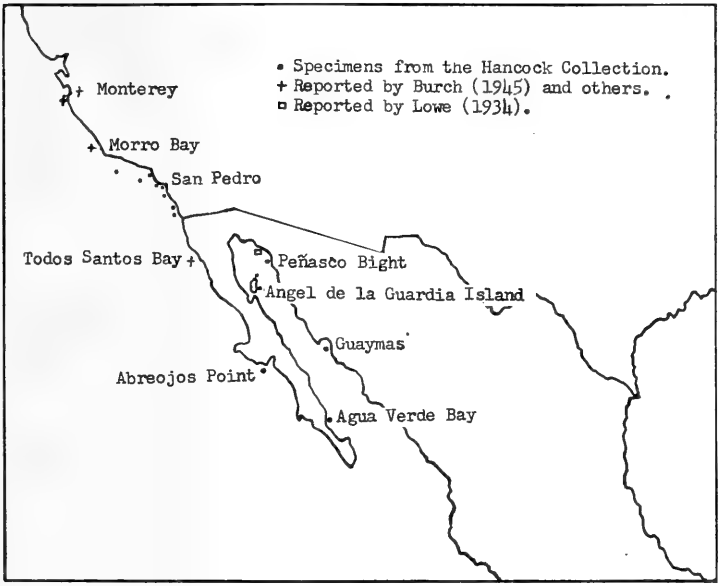

PLATE 35

Map of western North America showing the locations from which *A. californica* has been recorded and those of the present report.

Abreojos Point on the coast side of Baja California, Agua Verde Bay on the inner peninsular side and Guaymas on the Sonoran coast. Representative specimens are also in the collection throughout the upper Gulf of California. Plate 35 shows the reported distribution as it now stands.

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CORRIGENDA

Vol. 57, Part 1, page 13, middle of page, under last word of title—NODULES, insert name of the author—by W. Dwight Pierce.

Vol. 57, Part 1, pages 36-37, plates 13 and 14, the legends are correct but the illustrations should be reversed.

Word has just reached the editor's office of the death on June 27, of our valued member, Dr. Frank E. Peabody. A memorial notice will be published in the September-December issue of the Bulletin.

PROCEEDINGS OF THE ACADEMY

ANNUAL MEETING

May 9, 1958

Approximately 100 members and guests assembled for dinner at the Los Angeles County Museum at 6:30 P.M. Following introductions of persons at the head table, the President, Dr. Hildegarde Howard, called for the following reports:

SECRETARY'S REPORT, Gretchen Sibley

(Read by Ass't Sec'y, Lloyd M. Martin)
1957-1958

The Southern California Academy of Sciences met nine times during the fiscal year, with an average attendance of about seventy five members and friends.

Six meetings were held at the Museum, and dinner was served in the Museum Cafeteria preceding each meeting. The other three meetings were held elsewhere. The first meeting was held at the Southwest Museum, and dinner was served at the Casa de Adobe.

The Section on Physical Sciences arranged for a tour of the United States Steel Plant in Torrance, in March. Members met at the Museum for dinner and later visited the plant.

In April the Section on Zoology took the members to Marineland of the Pacific for dinner and a lecture at Marineland.

Membership for the year was as follows:

Life Members	8	Honorary Life Members	6
Honorary Members	3	Unlimited Annual Members	157
Unlimited Junior Members	19	Limited Annual Members	33
Limited Junior Members	5	Fellows	38

Total Members 231
Bulletin Subscribers 54

ANNUAL REPORT OF THE TREASURER FOR THE FISCAL YEAR 1957-1958, ENDING MAY 1, 1958.

(ABSTRACT)

General Fund

Receipts		Disbursements	
Bank carry over 4/23/57	$ 497.60	Annual meeting, banquets	$ 475.41
Membership dues	981.20	Monthly meetings	174.91
Sale of publications	337.46	Printing & engraving	3,074.66
Investment returns	2,563.97	Office expense, postage	212.63
Banquets, annual, etc.	367.00	Portfolio investment	659.87
For Memorial Fund	42.59	Memorial Fund	42.59
Borrowed from Mem. Fund	200.00	Research grants	100.00
A.A.A.S. Grants	100.00	Bank charges	4.33
Certificates	2.00	Balance in bank 5/1/58	366.63
Refunds and Rebates	19.21		
	$5,111.03		$5,111.03

Memorial Fund

Receipts		Disbursements	
Bank carry over 4/23/57	$1,037.01	Lent to general fund	$ 200.00
Interest on deposits	42.59	Balance in bank	879.60
	$1,079.60		$1,079.60

CONDITION SUMMARY AS OF MAY 1, 1958

ASSETS		LIABILITIES	
Cash in general fund	$ 366.63	Publications in press	$ 700.00
Memorial fund	879.60		
Postage account cash	16.55	Safe deposit box	5.50
Postage on hand	6.18		
Securities, market value	50,709.71	Net worth	66,363.67
Inventory, approximate	14,590.00		
Accounts receivable	40.50		
	$67,069.17		$67,069.17

The return on investments for the present fiscal year averaged 7.3% on original cost, and 5.5% on present valuation.

Income from investments and membership dues exceeded that of last year, but returns from sale of publications were lower.

W. DWIGHT PIERCE,
Treasurer

AUDITOR'S REPORT, Allen W. Steuart

As auditor of the Finance Committee, I hereby certify that I have examined the books and records of the Academy for the fiscal year ending May 1, 1958, and have found the attached financial statements prepared by Dr. Dwight Pierce, Treasurer, to be correct. The statements consist of a balance sheet and a cash receipts and disbursements statement for the year and are certified subject to the following explanations and comments.

The inventory as shown on the balance sheet consists largely of bulletins and is shown as what is believed to be their estimated market value. The securities shown consist of stocks traded on the exchange, and government bonds. They are likewise shown at fair market value based upon bid prices for stocks and at redemption value for bonds. None of the securities on hand at the beginning of the year were sold, and a few additional stocks were purchased.

The only liabilities on the balance sheet are an estimated $700.00 due a printing company for certain printing which has not yet been completed, and the amount due for rental of a safe deposit box.

Verification of the financial statements consisted of a reconciliation of the bank account, test checking of certain invoices to verify accuracy of posting in the books, and a count of the securities in the corporation's safe deposit box which was made in the presence of Dr. Pierce.

It is apparent from a review of the books that the work requires a great deal of the Treasurer's time over the course of a year, and it is felt that Dr. Pierce should be commended for his painstaking care in keeping an accurate record of the Academy's income and expenses and in managing its property.

EDITOR'S REPORT, Dr. John A. Comstock

The publications of the past fiscal year have been limited to three issues of our "Bulletin". It has been possible to maintain these at a high standard of content and volume notwithstanding the increase in costs of engraving and printing.

No funds have been available, however, for the issuance of Memoirs.

The report of the Treasurer evidences the fact that the major item of outlay in the Academy budget is that of publications. This is a service to science that reflects credit on our organization and membership. Our Bulletin has a wide circulation among libraries, museums, governmental agencies and specialists, thereby making available the results of basic research in several branches of the natural sciences.

This year of 1958 marks the thirty eighth consecutive year in which I have had the privilege of functioning as your editor. It has been a stimulating and pleasurable task, and I hope that it has earned your continuing approval.

REPORT OF THE COMMITTEE ON SELECTION OF RECIPIENT OF A.A.A.S. RESEARCH GRANT

Dr. Louis C. Wheeler, Chairman

The $50. grant for the year 1958 was awarded to Dr. W. Dwight Pierce for continuing of his work on fossil insects in Miocene nodules from the Calico Mountains of California.

REPORT OF THE COMMITTEE ON FELLOWS

Dr. Fred S. Truxal, Chairman

The Degree of Fellow was awarded, and certificates presented to: Dr. Theodore Downs; Dr. Frank E. Peabody, and (in absencia) Dr. Vincent Dethier.

REPORTS OF RESULTS OF THE ELECTION OF DIRECTORS AND ADVISORY BOARD

Dr. Sherwin F. Wood, Chairman,

Nominating Committee

Directors

A. Weir Bell	Lloyd M. Martin
Thomas Clements	W. Dwight Pierce
John A. Comstock	Gretchen Sibley
Theodore Downs	Kenneth E. Stager
Hildegarde Howard	Fred S. Truxal

Sherwin F. Wood

Advisory Board

J. Stanley Brode	Theodore Payne
Charles Burch	Frank E. Peabody
Howard R. Hill	Ruth D. Simpson
Dorothy Martin	Richard Swift

Louis C. Wheeler

The Group then adjourned to the North American Habitat Hall, where another hundred guests had already assembled, to hear the program of the evening, an address by Dr. Joseph Kaplan, United States National Committee Chairman of U.S. Activities, International Geophysical Year.

Dr. Kaplan, speaking on the International Geophysical Year, explained the history of international cooperation in geophysical study, starting with observations concerning the Arctic in 1882 in which stress was laid on gathering data concerning the northern lights and the changes of the earth's magnetic field. The present 18 months' period, from July 1957 to the end of December 1958, was selected because of peak activity of the sun during this time. He explained the varied program now under way, including studies of world weather, earth's magnetism, the sun, glaciers, oceans, cosmic rays, and outer space. The launching of earth satellites plays an important role in these studies, not only as an achievement in itself, but, more particularly because of the information that science hopes to obtain concerning outer space from the behavior of these satellites and the instruments they contain.

The keynote throughout Dr. Kaplan's talk was the significance of international cooperation in obtaining basic scientific information about our planet and the universe — the heartening fact that scientists can unite for the good of man, and the hope that politicians of the future may follow suit.

BOARD OF DIRECTORS

At the meeting of the Board of Directors subsequent to the annual dinner, the following business was transacted.

New members elected: Boolootian, Richard A., Dept. Zool., U.C.L.A. (Invert. Zool.); Northern, James, L.A. County Museum (Ornithology-Mammalogy, limited Jr., member); Wilson, Cecil, 1319 West 7th St., Santa Ana (Physics); Honey, James, L.A. County Museum (Zoology; limited member).

Dr. Joseph Kaplan was unanimously elected an Honorary Life Member.

Mr. Theodore Payne was appointed to represent the Academy at a meeting of the County Planning Commission to decide on the zoning of the Big Tujunga Wash area.

The present officers of the Academy were all unanimously re-elected to serve in 1958-1959.

June 20, 1958

About 75 members and guests assembled for the last meeting of the 1957-1958 Academy year. Dr. Fred S. Truxal, first vice president, presided. The names of the officers, and committee and section members for 1958-1959 were read. These lists will appear in the fall issue of the Bulletin.

Dr. Hildegarde Howard, as president for 1957-1958, discussed the most recent research in her field of science, under the title "Highlights in the Study of Fossil Birds." Stating that nearly 50 per cent of the 500 fossil avian species recorded in the United States are known from California, Dr. Howard reviewed some of the species that she herself has studied. Particular mention was made of two birds from the Miocene epoch: (1) A gigantic marine bird with jaws bearing bony, toothlike projections; this bird was estimated to have had a wingspread of 16 feet; it was recovered in Santa Barbara county by the Santa Barbara Museum of Natural History,

and described by Dr. Howard as representing an extinct family. (2) A specimen of smaller marine bird, a booby, found in two slabs of shale by the Pohl brothers of Studio City, in a deposit on Ventura Blvd.; the boys gave one slab to the Los Angeles County Museum and this will become the type specimen of a new species. Dr. Howard discussed the pros and cons of describing fossil birds from a single bone, citing the giant "toothed" bird as an example of a species in which one bone would not have been sufficient to reveal the characters of this extinct form, whereas another fossil, *Mancalla*, from the Pliocene, was very successfully described from a single wing bone, as proven by later discoveries of all skeletal elements. Dr. Howard mentioned that some of her studies have demonstrated evolutionary changes within avian species, and distributional changes from one epoch to another. Of particular value in observing such changes she cited the large collection from the Rancho La Brea asphalt deposits. Comparison of the Rancho La Brea skeletons with those of living birds demonstrates that some species have lived on into the present with no apparent anatomical change, others show differences of such slight degree that they seem clearly to be ancestral to the living forms, and still others, abundant in the Pleistocene, have become very rare today or have died out completely. The Rancho La Brea collection also reveals the presence of species in the Los Angeles area in the Pleistocene that are extant in other parts of California today but not in the Los Angeles Basin area. The talk was illustrated by actual fossil specimens.

BOARD OF DIRECTORS

New chairmen of Sections and Committees were invited to meet with the Board of Directors and Advisory Board following the June meeting. Dr. Howard, president elect, presided.

Mr. J. Stanley Brode was elected as the Academy's representative to the American Association for the Advancement of Science, and Dr. John S. Garth was named as an alternate. The following names were proposed for membership and approved: Clarence R. Shoemaker, U. S. National Museum, Washington, D. C. (Marine Amphipoda); Wm. D. Stockton, 3310 Ransom Street, Long Beach 4 (Entomology); Wm. R. Webb, Webb School, Claremont (Anthropology); John P. Farquhar, 1835 North Ogden Drive, Hollywood 46; Arnold Hoffman, 3867 Edgehill Drive, Los Angeles 8 (Junior member).

The Section chairmen were called upon to discuss their proposals for speakers during the 1958-1959 season. The Section on Zoology has now been divided into a Section on Vertebrate Zoology and a Section on Invertebrate Zoology, and the previous Section on Entomology has been discontinued; a Committee on Special Events has been added to arrange for one trip during the season and for the program of the Annual Meeting.

SCIENTIFIC NOTES

CONENOSE BUG AND TRYPANOSOME OBSERVATIONS FOR 1957 FROM SOUTHWESTERN NATIONAL PARKS AND MONUMENTS

Cooperative collecting by Park Superintendents, archeologists, and naturalists during 1957 revealed 34 *Triatoma* from the following sources: Carlsbad Caverns, New Mexico, 1♂ *protracta woodi,* 6 ♂, 3 ♀ *sanguisuga indictiva;* Clarkdale, Arizona, 1 ♂, 2 ♀ *rubida uhleri;* Gila Pueblo and Globe, Arizona, 1 ♂, 2 ♀ *rubida uhleri;* Montezuma Castle, Camp Verde, Arizona, 1 ♀ *protracta protracta;* Montezuma Well, Rimrock, Arizona, 1 ♂, 2 ♀ *protracta protracta,* 1 ♂ *recurva (longipes);* Tucson, Arizona, 1 ♂, 7 ♀ *rubida uhleri;* and Tuzigoot, Clarkdale, Arizona, 1 ♀ *protracta protracta,* and 1 ♂, 2 ♀, and one 5th instar nympth of *rubida uhleri.*

The Carlsbad Caverns *protracta woodi* and 1 ♀ *sanguisuga indictiva* were found under a damp cloth beneath the kitchen sink and on the living room floor, respectively, of one residence in the evening after dark. From the same residence, 1 ♂ *sanguisuga* was found on the outside of the front screen door at 4 AM. From another residence nearby, 3 ♂ *sanguisuga* were found in the bathroom on different nights at 2, 3, and 3:30 AM, respectively, while another ♂ was captured in the living room at 10 PM, and a ♀ was also found inside the home. From a third residence, a ♂ *sanguisuga* was collected from the outside screen surface of a back door and from a fourth residence, one ♀ *sanguisuga* was found inside the house (R.T.H., T.C.M., P.F.S.). The Clarkdale ♀ *rubida* were found in the living room and breakfast nook at 10 and 9 PM, respectively, while the ♂ was collected in the morning (F.R.P.). The Gila Pueblo ♀ *rubida* was found "on top of a tier of shelves in the mailing room" and the other ♂ and ♀ came from Globe (E.J.). The Montezuma Castle ♀ *protracta* was picked up from the Museum floor at 8:15 AM (G.R.W.). The Montezuma Well *protracta* were found in the residence on floor and walls after dark in the early evening but the *recurva* was taken outdoors "alive at the well outlet about 4 PM on July 9th" (G.R.W.). The Tucson *rubida* came from one human dwelling (G.R.W., D.B.). The Tuzigoot ♀ *protracta* was found in the residence along with 2 ♀ *rubida* while 1 ♂ *rubida* was collected in the ladies rest room and the 5th instar *rubida* nymph was found in the wash room (J.W.S., F.R.P.). All the above specimens were collected between June 18 and August 15, 1957.

Examination microscopically of the feces of the 33 adult bugs revealed: 2 ♂ *sanguisuga indictiva* from Carlsbad Caverns; 1 ♂ and 1 ♀ *rubida uhleri* from a Clarkdale residence; 1 ♂ and 1 ♀ *rubida uhleri* from Globe; 1 ♀ *protracta protracta* and 1 ♂ *recurva (longipes)* from Montezuma Well; 1 ♀ *rubida uhleri* from Tucson; and 1 ♀ *protracta protracta* and 1 ♂ and 1 ♀ *rubida uhleri* from Tuzigoot naturally infected with a trypanosome morphologically indistinguishable from *Trypanosoma cruzi* Chagas. This infection rate of 36.3% is the highest observed for any previous sampling of this area (Wood, 1953, 1954, 1955, 1957, Bull. So. Calif. Acad. Sci. *52*:57-60; *53*:52-56; *54*:43-44; *56*:51).

Wood (1944, Bull. So. Calif. Acad. Sci. *42*:115-127) has previously called attention to the possibility of finding trypanosome infected insects by examination of wet or dried feces of DEAD bugs. Since the intestinal and rectal contents of the gut do not dry out as rapidly as the surface structures,

wet enteral contents can be found many days after death. Verification of the usefullness of this fact in examination of bugs for intestinal parasites is demonstrated here since most of these insects were killed by heat under natural conditions and received for microscopic examination in the "dry" form in hand-excavated rectangles in corrugated cardboard mailers. These 11 records reveal detection of dead crithidiform, trypanoform or recognizable remnants of *Trypanosoma cruzi* on the 4th, 5th, 6th, 13th, 14th(2), 15th, 17th (3), and 21st days after reported capture. All diagnoses not verifiable as to specific identity are recorded as suspicious or negative. Therefore, the infection percentages reported by the writer are considered minimal.

This is the first report of recognition of *Trypanosoma cruzi* in *Triatoma sanguisuga indictiva* from Carlsbad Caverns, New Mexico; in *Triatoma rubida uhleri* from Globe, Arizona; and in *Triatoma protracta protracta* and *Triatoma recurva (longipes)* from Montezuma Well, Arizona, which is 6 miles NE of Montezuma Castle.

The writer wishes to thank the following contributors, mostly of the National Park Service, for their unrivaled cooperativeness: Supt. R. T. Hoskins, Acting Supt. T. C. Miller and Naturalist P. F. Spangle, Carlsbad Caverns National Park; Naturalist E. Jackson, Gila Pueblo; Archeol. G. R. Wenger, Montezuma Well and Montezuma Castle; D. Barger, Tucson; Supt. J. W. Stratton, Tuzigoot; and Archeol. F. R. Peck, Tuzigoot and Clarkdale. — Sherwin F. Wood, Life Sciences Department, Los Angeles City College, Los Angeles 29, California.

RANDOM NOTES ON EARLY STAGES OF LEPIDOPTERA.

Among the group of younger entomologists that have come under the influence of the educational program of the Los Angeles County Museum there is one in particular whose field notes, and observations recorded in letters, have from time to time given data that is not on record in the literature. I refer to Noel McFarland, now a student in the University of New Mexico.

Noel has been most generous in sharing his information, and specimens with others, as a result of which a considerable quantity of new data has been made available for publication.

This brief release concerns two rare moths from the southwest, namely, *Coloradia luski* B. & B., and *Hemihyalea splendens* B. & McD., for both of which no information is on record concerning their early stages.

Coloradia luski B. & B.

The holotype and allotype of this rare saturniid were taken in the White Mountains of Arizona, "presumably" by R. D. Lusk. The species was described by Barnes and Benjamin in Vol. 3, page 13 of the Pan Pacific Entomologist, 1926. The types bear no dates.

Two eggs were obtained from a gravid female captured at Parks, Arizona, August 13, 1956 by Noel McFarland.

Egg: Ovoid; length, 3 mm. Width, 2.2 mm.

The egg is laid on its side. Its color is light gray, with a large black spot in the center of the larger end. Its surface is finely granular.

The first egg hatched September 11, and the second, September 13, 1956. Egress of the larva was made through the larger end of the egg at the

point of location of the large black spot. The remainder of the shell was left practically intact.

The young larvae were offered pine and oak, neither of which were accepted. This does not mean that one or the other of these plants may not be the natural food plant, as it is well known that newly emerged larvae must have exactly the right condition of food and environment in order to negotiate their start in life. These conditions are difficult to simulate in the laboratory.

The two larvae died shortly after emergence, but not before brief notes were made of the —

First instar. Length, 5 mm. Head width, approximately 1.4 mm., which is considerably wider than the first cervical segment. It is jet black, with a scant covering of long curving white setae.

The body is dull olive green. There is a narrow middorsal black stripe running longitudinally. This is margined with white. There is also a faint indication of similar, though narrower lines running dorso-laterally and substigmatally.

Each body segment bears a transverse row of long yellow spines, those of the thoracic and caudal segments being topped by a pair of long yellow hairs. The remaining segments have single hairs on the tip of the spines,

The true legs are black. The prolegs are concolorous with the body, except the terminal pads, which are translucent yellow.

Hemihyalea splendens B. & McD.

This 'splendid' arctiid was first described by Barnes and McDunnough in the Journal of the New York Ent. Society, Vol. 18, 1., 149, 1910. A colored illustration of the imago is shown on Plate III, figure 6 of Hampson's Supplemental Vol. II, Catalog. Lep. Phalaenae.

Eggs were obtained by Noel McFarland from a gravid female of this species, taken at the 7 C Bar Guest Ranch, seven miles west of Williams, Coconino County, Arizona, between August 9th and 15th, 1956. It was impossible at the time to make notes of the eggs, but the first instar was recorded shortly after hatching.

Larva of 3 mm. length:

Head, jet black, the mouth parts slightly hyaline; wider than the first cervical segment. Width of head, .55 mm.

Body, ground color smoky yellow, with a prominent black scutellum on the first segment.

Each typical body segment bears a transverse row of raised black papillae, placed in a zig-zag pattern. Each papillus bears a tuft of stiff black hairs, those on the first and caudal segments being the longest.

The legs are black and slightly translucent, and the prolegs are black on the two proximal segments and hyaline on the distal. The crochets are black.

The larvae were offered oak, walnut, and *Rhus laurina*. They fed on oak for a short time, but did not reach the second instar.

John A. Comstock,
Box 158, Del Mar, Calif.

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(*Continued on next page*)

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A List of North American Lepidoptera in the Los Angeles County Museum. Part I Butterflies (Suborder Rhopalocera), Lloyd M. Martin and Fred S. Truxal. L.A. County Museum Science Ser. #18. Zool. #8, 1955. Price $1.00 (add 15 cents for tax and mailing).

Reprints:

Check-list of the Lepidoptera of Boreal America. Superfamilies Sphingoidea, Saturnioidea and Bombycoidea (printed on one side of page only, to allow of additional notes), Wm. Barnes and Foster H. Benjamin, 1927 $ .50

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BULLETIN OF THE

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ERRATUM: p. 176, line 39, para. 5, substitute Geological for Geographical.

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FACTORS AFFECTING NEOTENY IN THE SALAMANDER *DICAMPTODON ENSATUS* (ESCHSCHOLTZ)

By FREDERICK W. SCHUIERER
University of Southern California
Los Angeles 7, California

The occurrence of neoteny in the Pacific giant salamander, *Dicamptodon ensatus*, has been recognized for some time (Cope 1889) and has been presumed to be induced by physiological mechanisms similar to those producing the conditions in other ambystomids. Little consideration has been given, however, to the environmental factors responsible for neoteny in this species.

Although the life history is not well-known, it appears that *Dicamptodon* may metamorphose any time after the first year. The smallest known transformation size is 96.5 mm. in total length (Reed 1949). First year larvae average 100 mm. and metamorphosis usually occurs during the second year when the larvae average 136 mm. in total length (Kessel & Kessel 1944). Under adverse ecological conditions metamorphosis may be delayed. If conditions are favorable for the aquatic stage, *Dicamptodon* remains in the water for several years or permanently. In the light of the average transformation size it may be assumed that larvae greater than 200 mm. in total length represent neotenic forms (Graf, Jewett & Gordon 1939).

While conducting a survey of the biota of Mount Tamalpais, Marin County, California, during the summer and fall of 1953, collections of *Dicamptodon* were made along Corte Madera Creek and a tributary, particularly in the area of the Ralston E. White Estate. Numerous large *Dicamptodon* larvae were seen during this time and four were collected on the following dates, (measurements are in total length): July 21, 1953, 237 mm.; October 10, 1953, 229 mm.; October 11, 1953, 210 mm. and 240 mm. It is presumed that these larvae are neotenic although no gonadal examination was made. The specimens were obtained from shallow pools spaced a few meters apart over a distance of 185 meters. The pools were from 10 to 70 cm. deep and were about 3 meters long and 1.5 meters wide and contained water throughout the year. The oxygen content of the creek was measured on

October 17, 1953, 4:00 P.M. and was found to be 33 parts per million. The air temperature was 18.9°C and water temperature 13.9 C. The area through which the stream passes is well shaded by redwoods *(Sequoia sempervirens)* and valley live oak *(Quercus agrifolia)*. The banks overhang the pools on one side in some places and are steep at various points.

Stebbins (1951) has suggested that neoteny may be common in areas where stream banks are high and steep-sided. The banks along Corte Madera Creek are low in places with many rocks which afford an easy exit to an animal with obviously powerful limbs, as *Dicamptodon ensatus*. The food supply is adequate. The water is well oxygenated. The protection and water temperature, which averages about 15.5°C, seem ideal for *Dicamptodon ensatus*. Kessel & Kessel (1943-1944) in their very thorough study of the metamorphosis of *Dicamptodon*, raised the question of correlation between the rainfall in the preceding spring and the possible effect on the second year larvae. They indicated that because of the adequate water, the larvae continued to remain in the deeper pools. They reported that Storer's (1925) 247 mm. specimen from this same area was captured under favorable conditions of rainfall. To my knowledge, only one adult specimen has been collected on the White Estate, in the vicinity of Corte Madera Creek, although a large concentration of larvae are nearly always seen there.

A review of the available literature indicates that neotenic larvae have been collected from the following areas:

California,
- Humboldt County; Fair Oaks
- Marin County; Muir Woods — Storer (1925)

Oregon,
- Clackamas County; Oak Grove — Bishop (1947)
- Multnomah County; Eastmoreland Golf Course, Portland
  - Eagle Creek — Reed (1949)
- Jackson County; Rogue River, South of Table Rock
  - Birds Eye Creek — Fitch (1936)
- Josephine County; East Fork of Illinois River — Fitch (1936)
  - Bolin Lake — Graf, Jewett & Gordon (1939)
- Benton County; Marys Peak — Graf, Jewett & Gordon (1939)
- Linn County; Santian River, 6 miles above Foster — Graf, Jewett & Gordon (1939)

From these data, it appears that the availability of water and other environmental factors give neoteny an adaptive advantage. The following factors seem to be significant in producing neotenic *Dicamptodon*.

1. A year-round water supply.
2. Well oxygenated water.
3. A fairly constant water temperature, varying slightly, about 16°C. The variance of temperature thus does not serve as a "trigger mechanism" for metamorphosis.
4. An aquatic food supply.
5. Protection afforded by the habitat.

The above conditions lead me to conclude that *Dicamptodon* need not metamorphose, but do so when aquatic conditions become untenable. The neotenous condition increases the adaptive potential of this salamander, and in light of its life history and relative scarcity of adult individuals, neoteny probably is common in areas where conditions are similar to those at Corte Madera Creek. The occurrence of large larvae in disjunct areas indicates that neoteny is probably common throughout the range of *Dicamptodon.*

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NOTES ON THE DISTRIBUTION OF CONCHOSTRACANS IN CALIFORNIA

By

DONALD M. WOOTTON[1]

and

NORMAN T. MATTOX[2]

Information concerning the occurrence of phyllopod crustaceans in California is limited to only a few reports. With the view of extending the meager knowledge of the California forms, extensive collections were undertaken during the summers of 1954 and 1955 in the Sierra Nevada. Supplemental collections were also made in the winter and spring of 1955 and 1956 in portions of the southern half of the state. This paper reports only on the Conchostraca. The results of the studies on distribution of Anostraca will be published at a later date.

Baird (1866) was first to describe a conchostracan from California. He described *Estheria newcombi* as a new species. His description was brief and not complete. Daday (1915) treated the form as a *species inquirendae* and it was not recognized by Pearse (1918) or by Pennak (1953). The name should be dropped from the literature, but it is of interest as the original description of a conchostracan from California.

Packard (1874) reported on a new species, *Estheria californica*, collected by James Behrens from Alameda County, California.

In 1895 Richard described *Eocyzicus (=Estheria) digueti* from Purissima, Baja California. Richard suggested that his species might be the same as described from California by Baird as *E. newcombi*. Daday suggests that *E. newcombi* may be the same as *C. californicus*, but incomplete description leaves a final decision impossible. This species was described from a collection of conchostracans which also included 42 specimens of *Leptestheria (=Estheria) compleximana* (Packard).

No further reports of the occurrence of conchostracans in California appeared in the literature until the report of Mattox (1957) describing *Cyzicus elongatus* Mattox.

The present investigation indicates that the conchostracans are well represented in the phyllopod fauna of the state, but are represented by relatively few species. Three species in the genus *Cyzicus* and one species of the genus *Lynceus* have been found in the present series of collections.

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The predominent conchostracan is *Cyzicus elongatus* Mattox, originally reported from Los Angeles County. It was found widely distributed in ponds in Santa Barbara, San Luis Obispo, Kern, Tulare and Fresno Counties. As is typical of conchostracans this species was usually found in relatively small temporary ponds of less than one-quarter acre in extent. Such pools varied in depth with the rainfall but usually were not over 2-3 feet deep. The pools were normally dry by the first part of July and did not collect water until the following December or later in some instances. *C. elongatus* is reported only from California.

Cyzicus californicus (Packard) was collected from Devereaux Pond, Goleta; three ponds on the slopes of Figueroa Mountain, Santa Ynez; and a pond near Betteravia in Santa Barbara County. Devereaux Pond was over an acre in extent and at least four feet in depth when filled to capacity. The other ponds were all rather small and shallow. Dr. Donald P. Abbott sent the junior author a vial of specimens of this species collected on the Stanford campus at Palo Alto in May, 1951, and also a collection by R. I. Smith from Oakland, California, collected March 2, 1952. *C. californicus* has been reported only from California.

Cyzicus mexicanus (Claus) was collected from pools in a hummock area five miles above Lindsay, Tulare County. Collections were made from these pools in the spring of both 1954 and 1955. *C. mexicanus* has been reported as being widely distributed in the eastern states and in the plains region of the central United States, but it had not been previously reported from California.

All three species of *Cyzicus* are distributed at low elevations in Southern California. *C. californicus* is primarily restricted to the coastal region. *C. elongatus* has both a wide distribution and a wide range of habitats, extending from Los Angeles and Santa Barbara along the coast, through the San Joaquin valley and into the foothills of the southern Sierra Nevada.

Lynceus brachyurus Müller was also collected from California. This species was found in a small pool in Blaney Meadows just off the trail from Florence Lake which connects with the John Muir Trail in the Sierra Nevada. The pool, at an elevation of 8,300 ft., is not over three feet in depth but does not become completely dry in the late summer. *L. brachyurus* is widely distributed in the north-eastern quarter of the United States but has also been reported from Colorado and Oregon. This is the first record of its occurrence in California.

During the early summer of 1955, the senior author collected phyllopods during an extended trip through the western United States. Information concerning extension of the range of the

following conchostracans is added to this report.

Eocyzcus digueti (Richard) was found thirteen miles east of Charleston, Kansas, associated with *Caenestheriella setosa* (Pearse), *Leptestheria compleximana* (Packard) and the fairy shrimp, *Streptocephalus texanus* Packard and *Thamnocephalus platyurus* Packard. The record of *E. digueti* is new for the state of Kansas. *E. digueti* was also collected by Mr. P. Perry from near Boulder City, Nevada. This is a new distribution for that state.

This study on the occurrence of phyllopods in the state of California is to be continued with special emphasis on the more northern areas of the state.

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A SCALARIFORM MICRARIONTA FROM BAJA CALIFORNIA NORTE, MÉXICO

By ROBERT J. DRAKE*

In April of 1940 Mr. Emery P. Chace collected a dead scalariform specimen of *Micrarionta (Plesarionta) stearnsiana* (Gabb) in the narrow La Misión valley, Baja California Norte, México. He has kindly permitted me to report upon the landsnail oddity as a part of general Baja California molluscan research; this program has been supported on the Peninsula (1953) and in the San Diego region (1954 and 1957) by the Bache Fund of the National Academy of Sciences.

The imperforate univalve, San Diego Museum of Natural History No. 13142 (Plate 36, figs. 1-3), measures: height, 24.7 mm.; width, 20.9 mm.; aperture height, 11.5 mm.; aperture width, 12.0 mm.; 5½ whorls; weight, 0.7 grams. It has a thinner shell than other specimens of *M. stearnsiana* from this locality (Plate 36, fig. 4) examined in several collections in southern California. As shown, in front view (Plate 36, fig. 1), parts of the third and fourth whorls were fractured after they were formed; soil in the aperture and the bleached condition attest to the shell having been a "bone" when found. The whorls were developed not quite separated (thus "scalariform"). It has almost a complete aperture with a parietal callus, but no lip was formed. It was nearly full grown.

Also illustrated (Plate 36, figs. 5-6) is a normal shell of *M. stearnsiana,* not bleached and apparently recently dead when collected by Wendell O. Gregg and R. J. Drake on 20 November 1954 at Kilometer 64 (Highway 1) in La Misión valley. It has been deposited as University of Arizona Invertebrate Museum No. 352. It measures: height, 23.5 mm.; width, 27.6 mm.; aperture height, 14.4 mm.; aperture width, 15.5 mm.; 5¾ whorls; weight, 2.2 grams.

L. E. Daniels (1912: 41; pl. 5, fig. 16) discussed and figured a similar appearing shell of *Oreohelix strigosa depressa* (Cockerell) which he collected from Jacob's Canyon, Kaibab Mountains, Arizona in 1910.

Examination of the remnant spire of the scalariform *Micrarionta* from northwestern Baja California revealed that no apparent shell injury took place during growth of the early whorls. Alan Solem (1953: 19), in addition to reviewing briefly the American literature on abnormal landshells, has inferred that experimental injury of young snails might throw light on the development of scalariform and other abnormalities. Somewhat in this respect, Charles Oldman (1931) presented notes on scalariformity possibly resulting from heavy infestation of mites.

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*Department of Zoology, University of Arizona

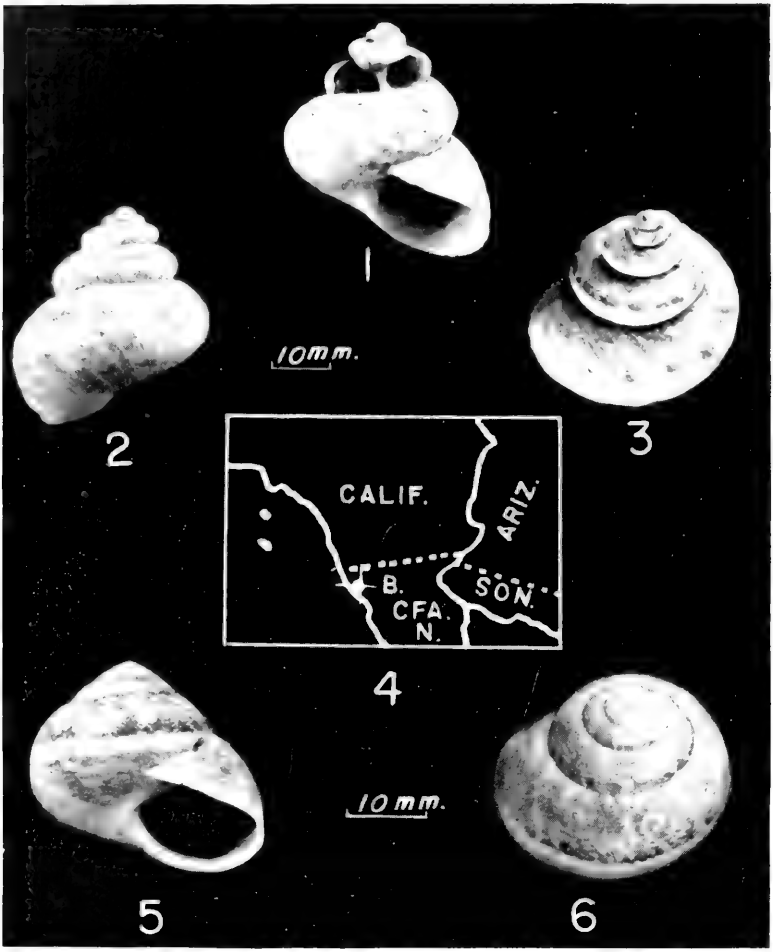

PLATE 36

Figs. 1-3. *Micarionta stearnsiana* (Gabb), scalariform shell. S. D. M. N. H. No. 13142.

Fig. 4. Location of La Misión valley, Baja California Norte, México.

Figs. 5-6. *M. stearnsiana*, normal shell. Univ. Ariz. Invert. Museum No. 352.

Tucson; 8 April 1958.

MORPHOLOGY OF THE COMMON MUDFLAT SNAIL, *CERITHIDEA CALIFORNICA*

By DONALD BOLTON BRIGHT

Almost any intertidal mud flat along the California coast will have some representation of the common California Horn-shell, *Cerithidea californica* (Haldeman) 1840.

Specimens have been recorded from Bolinas Bay, Marin County, California, to Baja California. Haldeman (1840) made the original description from a specimen taken in the San Francisco area. Since that description, numerous accounts of the abundance and ecological variations of *Cerithidea* have been reported (Gould, 1852; Carpenter, 1857; Berry, 1906).

Knowledge concerning the details of the morphology and histology of snails is becoming more important as information accumulates about their role as vectors for parasites of man, domestic and wild animals. Recent workers have found several new digenetic trematodes through studies of infected *Cerithidea.* Martin (1955) reports more than twenty species of trematodes found in this snail host. The relationships between man and the helminths have been well studied, but the relationship of the snail and the larval parasite stages is less adequately understood. Specific anatomical areas of infestation, and pathological effects produced by the parasite on the host, are often difficult to understand because the normal anatomy and histology of the various organs of the Mollusca are incompletely worked out.

Until recently the importance of *Cerithidea* as a vector was unknown. This, together with its small size, accounts for the fact that an anatomical study has never been done. Such a study to aid the understanding of parasitic infection in *Cerithidea* forms the basis of the material in this paper. To date no member of the family group has been studied in detail. General knowledge of histology and morphology of the Gastropoda is scattered, and hence such a study is felt to be a definite contribution. A comparative study of this species with others has not been practical since so little work has been accomplished on this group of gastropods.

The author is indebted to Dr. Norman T. Mattox, Dr. William V. Mayer, and Dr. John L. Mohr of the Department of Biology, University of Southern California, for their cooperation and interest in this study.

*Contribution No. 235 from the Allan Hancock Foundation, University of Southern California.

MATERIALS AND METHODS

All specimens studied were collected from the mud flats of the Upper Newport Bay area, east of Newport Beach, Orange County, California.

The shell was removed from the soft parts of the animal by carefully breaking the shell with a pair of pliers, then separating the columella muscle from the attached piece of shell.

Nembutal (sodium pentabarbitol), used in three-quarter grain (50 mg.) concentration per 75 ml. of sea water, relaxed the soft parts well. The relaxation technique of Van Der Schalie (1953) was employed. Those specimens left over night in this solution were completely relaxed the following morning and were anatomized.

Fresh radulae were dissected from anesthetized snails and studied in sea water medium. For permanent preparation, the radulae were placed in a 10 per cent potassium hydroxide solution for two or three days, then washed, dehydrated, and mounted in euparal. The presence of chitin in the radulae was determined by the method of Campbell (1929).

Heidenhain's "SUSA" solution (trichloroacetic with mercuric chloride) was the most satisfactory fixative. Absolute alcohol was not a suitable fixative, since noticeable changes were produced in the viscera.

Heidenhain's iron alum hematoxylin stain technique as outlined by Gray (1954) was employed. Best results were obtained by leaving the sections in a mordant for a 10 to 12 hour period. Regressive staining with the hematoxylin solution for a similar period of 10 to 12 hours was generally employed. Destaining with either 4 per cent iron alum or saturated aqueous picric acid was used.

All measurements given in this paper are those normal to 26 mm. snails, the average size of several hundred specimens collected. Measurements of specific structures are in all instances an average from five or more specimens. Throughout the paper, the terms right and left refer to the animals' right and left.

EXTERNAL MORPHOLOGY

The shell of *Cerithidea* is a calcareous, cone-shaped structure (Plate 37). The internal cavity of an adult shell makes eight complete dextral turns from the apex to the peristome. The columella is a solid supportive structure formed by the union of the inner edges of the shell wall.

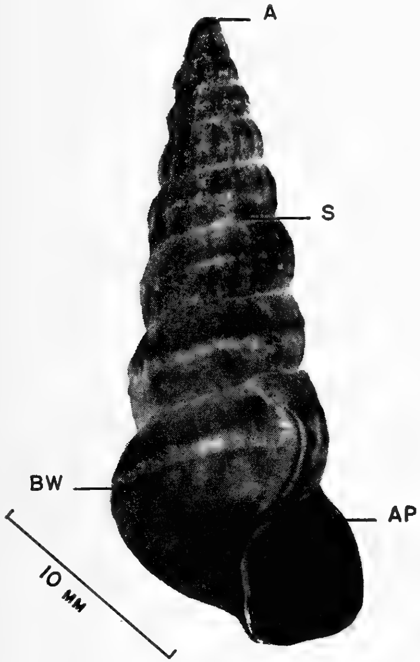

PLATE 37
External morphology of the entire shell.

Externally the whorls are indicated by narrow depressed lines, the sutures. Perpendicular to the sutures are many minute striations indicative of the respective layers added to the shell during growth. At varying intervals a transverse projection, the varix, interrupts the spiral. This marks the point where the mouth of the shell was located during an earlier period of growth. Measurements of shell length indicate that there is no direct relation between shell size and age. Shells of 26mm. in length have been found with one, two, or three varices. This indicates that shell size is not solely dependent on age, but rather a combination of both age and environment.

The aperture of the shell is bordered on the dorsal edge by a rim or outer lip; and on the ventral edge by an inner lip. At the lowermost position of the aperture there is a very slight depression, not as prominent as the so-called siphonal process of other species.

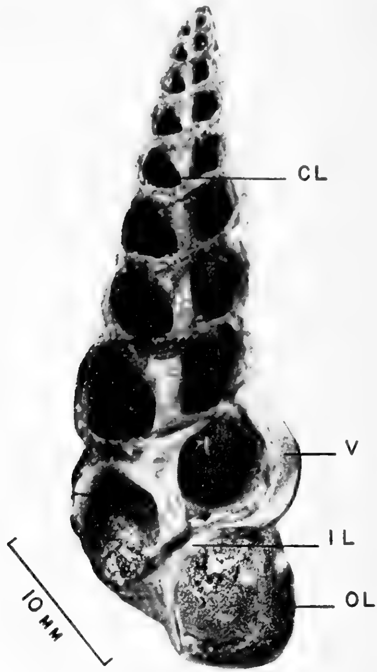

PLATE 38

Median longitudinal section of the shell, showing the internal spiral arrangement, columella, and aperture.

A chitinoid disc on the muscular foot, the operculum, blocks the aperture. The operculum increases in width and depth with age, since during each growth period a new layer is added to the inner surface of the previous operculum. A cross-section reveals a series of individual layers each applied to the other, with those of less diameter on the outer surface. Since this growth appears concentric around a central mass, the operculum is nucleate.

FEATURES OF THE VISCERAL SPIRAL

The foot of *Cerithidea* is capable of being extended longitudinally to 11 mm. and is 6 mm. wide. The ventral surface of the foot is a pallid neutral gray in life, while the dorsal areas of the body wall adjacent to this surface are a solid black. A cross-section of the foot reveals an outer epidermal layer composed of pseudostratified columnar epithelium, with a well defined basement membrane, basal vesicular or oval nuclei, and supranuclear granules. This layer of columnar epithelium also forms the thin layer of cuticle covering the external surface of the foot (except in the region of the pedal glands).

That portion of the foot between the epidermal layer and the head mass, is composed of a network of connective tissue and muscular fibers. The muscle fibers tend to form a moderately thick layer adjacent to the basement membrane of the surface epithelium. These muscle fiber bundles have a diameter of 2 microns. White connective tissue fibers are intermingled with these muscle fibers, and many free connective tissue cells occupy the interfiber spaces.

The anterior portion of the foot, composed of a network of connective tissue and muscle fibers, is the propodium. These structural elements extend posteriad to about the mid portion of the foot, the mesopodium, where a transition begins to a more densely muscular area, the metapodium. The metapodium bears the chitinoid operculum.

The pedal glands are clumped centrally in the mesopodial area, and have a common slit-like aperture, opening on the ventral foot surface. These glands are alveolar in arrangement, composed of cuboidal cells with basal, spherical nuclei. No ducts were found leading from the small clumps of cells to the central cavity of the glands; presumably these cells are exocrine in nature.

The surface of the visceral mass is covered by a thin, delicate non-pigmented layer of tissue, the mantle, which projects anteriorly to form the mantle collar. This collar is semicircular, pigmented, and covers the lateral and dorsal surface of the anterior third of the head mass. The cavity between the head and the collar is the mantle or pallial cavity. The covering of the mantle is simple squamous epithelium with a well defined basement membrane. Beneath this is a layer of longitudinal muscle. The mantle collar shows a transition from the squamous cells of the mantle to pseudostratified columnar cells. These columnar cells, near the posterior ventral limits of the mantle cavity, contain a large amount of supranuclear mucoid material.

The head region extends dorsally from the foot, and is continuous with the lateral portions of the foot. The head is covered by a heavily pigmented layer of epidermis consisting of pseudostratified columnar epithelium. This layer is black with scattered pale drab-gray areas. The head is 4 mm. in length when relaxed, but can be extended to 8 mm. About two-thirds of the way posteriorly on the lateral surface of the head is a pair of cylindrical tentacles, pigmented similarly to the epidermis of the head. These can be extended 5 mm., but are usually 1 to 2 mm. long in the relaxed state. The basal portions of each tentacle are enlarged laterally, bearing the eyes.

Posterior to the mantle collar, on the ventro-lateral surface of the first visceral spiral is the columella muscle (Plate 39). This affords the only point of attachment between the visceral mass and the shell. Columella muscle fibers are slender and quite elongated, with their nuclei elongated in the direction of the long axis of the fibers. Separate bundles of fibers are easily distinguishable, each with an average diameter of 7 microns.

The second visceral spiral has the kidney or nephridium located ventrally and on the right side. The stomach lies just dorsal to the kidney, but more posterior than the kidney. The style sac, with its crystalline style, extends anteriad and dorsal to the kidney, and enters the stomach.

The remaining visceral spirals are covered peripherally by the gonads, which lie just beneath the mantle tissue, extending mediad for 0.06 mm. The remaining space in these spirals is occupied almost completely by the digestive gland.

DIGESTIVE SYSTEM

The mouth opens at the anterior end of the head and leads into the buccal chamber (Plate 40-C). At the sides of the entrance to this cavity are two horny jaws. The jaws are composed of a series of closely associated bodies, the denticles, with only the buccal surface denticulated. This denticulation is not strongly developed as compared with that found in other forms having a more varied type of diet.

From the floor of the buccal cavity, along the long axis, projects the odontophore which supports the radula or lingual ribbon (Plate 40-C). The radula extends backward over the dorsal surface, then bends ventrally, ending in a dorsally curved blind pocket, the radular sac. The radula is supported by a subradular membrane, closely applied to the buccal cartilages. The radula consists of a series of rows composed of three types of teeth, central, lateral, first and second marginals, in a 2-1-1-1-2 pattern (Plate 40-D and E). These rows extend posteriorly toward the radular sac.

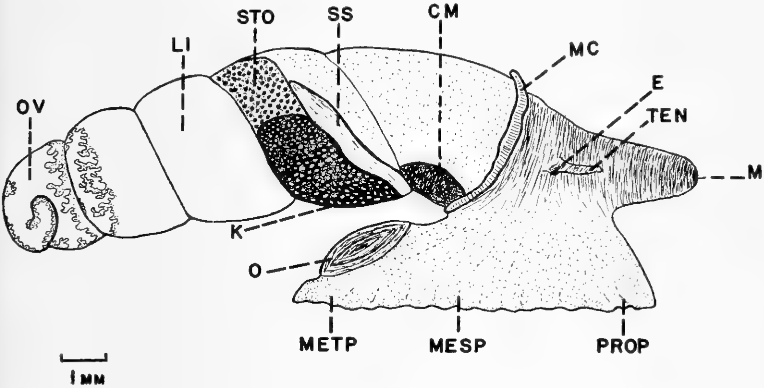

PLATE 39

Left lateral view showing the relationship of the organs in a de-shelled specimen.

The central tooth is almost square, with a small protuberance on each lateral surface. This tooth is usually tricuspid, though four cusps have been observed on the most posterior teeth. The lateral tooth has an elongated portion extending downward and laterally from the main body of the tooth. Cusps vary, but are usually four or five. The marginal teeth are elongated, with the cusped surface curved inward toward the central tooth. The first marginal tooth has five cusps, the second marginal from five to seven. Posteriorly the marginals are not well developed, and they gradually disappear, usually by the eighty-first row.

The number of teeth per row varies considerably in snails of the same size. No deviation in the parallel arrangement of the rows of teeth was observed. The total number of rows varied from eighty-five to one-hundred and five; the majority of specimens averaged ninety rows. There was some increase in the size of marginal teeth from anterior to posterior.

Radular teeth were found in fecal pellets from practically all specimens observed, indicating a continual replacement of teeth. No attempt is made here to explain how these worn teeth are replaced. The radulae were found to be composed chiefly of chitin.

The radula is supported by a pair of kidney-shaped odontophore cartilages, one under each lateral edge of the radula; these move with the radula providing continuous support. These two pieces of cartilage are composed of closely packed cells, having little intercellular matrix.

The entire buccal mass is supplied with a very complicated series of interacting smooth muscles, too complex for treatment here. These allow movements in all directions, including partial extrusion of the radula through the mouth. Histologically these muscles are similar to the foot and columella muscles previously described. Bundles of fibers are 2 to 3 microns in diameter. These muscles give the buccal mass a diamond-shaped appearance, and are chestnut red in life.

The buccal cavity leads to a flat, thin tube, the preoesophagus (Plate 40-A). When the head is relaxed, the preoesophagus appears convoluted. A cross-section shows an internal lining of columnar epithelial cells supported by a thin layer of scattered muscle fibers, and an equally thin layer of connective tissue. These columnar cells have oval nuclei with prominent nucleoli. The muscle layer fills the pockets created by the folds in the epithelial layer. Posteriorly, the preoesophagus opens into the ovoid crop (Plate 40-A). This is a structure with its surface folded inward to such a degree that it blocks the lumen when empty. These folds extend along both the lateral and transverse margins. The crop extends posteriorly in the head mass to a level even with the posterior limits of the pallial cavity. The crop differs histologically from the preoesophagus only in that the muscle layer is slightly thicker. Finger-like projections, lamina propria, extend between the folds of the epithelial layer.

On either side of the crop is a salivary gland (Plate 40-B). The left gland is largest, and more posterior than the right one. They are simple follicular glands with columnar cells opening into conspicuous ducts. From both glands highly convoluted ducts, partially embedded in the connective tissue of the preoesophagus, lead to the posterior margin of the buccal cavity.

The postoesophagus leads from the posterior limit of the crop, entering the stomach in the second visceral whorl. The postoesophagus, 7 mm. in length, after leaving the crop bends dextrad and ventrad. It is a twisted structure, and appears sacculated (Plate 40-A). It is histologically similar to the preoesophagus.

The stomach is a U-shaped tubular structure, leading posteriorly from the juncture with the postoesophagus, and then recurves dorsally. The stomach has many delicate finger-like folds projecting into the lumen. The stomach in a live specimen is antique green. Columnar epithelial cells (Plate 41-E) with supranuclear granular aggregations, and large basal nuclei line the stomach. Beneath this surface layer lies a thin submucosa, which projects a short distance between the bases of the epithelial cells.

In the middle of the stomach, on the left side, is the aperture

of the style sac. Within this sac is the crystalline style (Plate 40-A), a cylindrical, crystal-clear proteinaceous rod. This rod varies in length, and often tapers posteriorly to a point. The style sac extends anteriorly from the aperture, passing dorsally to the kidney, turns to the left side of the visceral mass ending on the dorsal surface of the second visceral spiral. The sac is methyl green externally, with an inner layer of iridescent multiciliated cells. This inner layer is composed of pseudostratified ciliated columnar epithelial cells with basal nuclei and dense aggregations of supranuclear granules (Plate 41-C). There is a transition from ciliated to nonciliated cells just anterior to the style sac aperture into the lumen of the stomach. A basement membrane is very well defined. The sac is covered by a thin layer of connective tissue. The inner layer of multiciliated cells produces a current which causes the crystalline style to be rotated.

The last three visceral spirals, six through eight, are filled by the digestive gland or liver, except for the area occupied by the peripheral gonads. The coloration varies from a raw-umber in freshly collected specimens to a claret-brown in partly starved animals. The whole branching liver complex is supplied with a meshwork of nerves, and an outer tunic of connective tissue with a good supply of blood.

The liver is a compound tubular gland, with each tubule covered externally by a thin layer of connective tissue (Plate 41-A). The internal surface area of the branched tubules greatly exceeds the inner surface of the remainder of the alimentary tract. A fibrous network of connective tissue cells, and scattered muscle fibers partially fill the intertubular space. Many irregularly shaped cells with prominent nuclei are found in the intertubular fibrous network. The inner lining of each tubule consists of a single layer of tall columnar cells (the shapes of these cells may vary from pyramidal to columnar), with large vesicular basal nuclei containing one or more prominent nucleoli, and generally small aggregations of chromatin material. Any section through this gland reveals several binucleated cells. The cytoplasm above the nucleus is filled by masses of minute secretory granules.

The tubular lumen of the liver functions as a sinusoid which, together with neighboring sinusoids, leads to a small ductule located on the ventral spiral surface. These ductules lead to larger ducts, pre-hepatic ducts, which empty into a single common hepatic duct. The hepatic duct passes anteriad and opens into the anterior end of the stomach, just posterior to the post-oesophagus-stomach junction. The hepatic duct is lined by pseudostratified ciliated columnar epithelium.

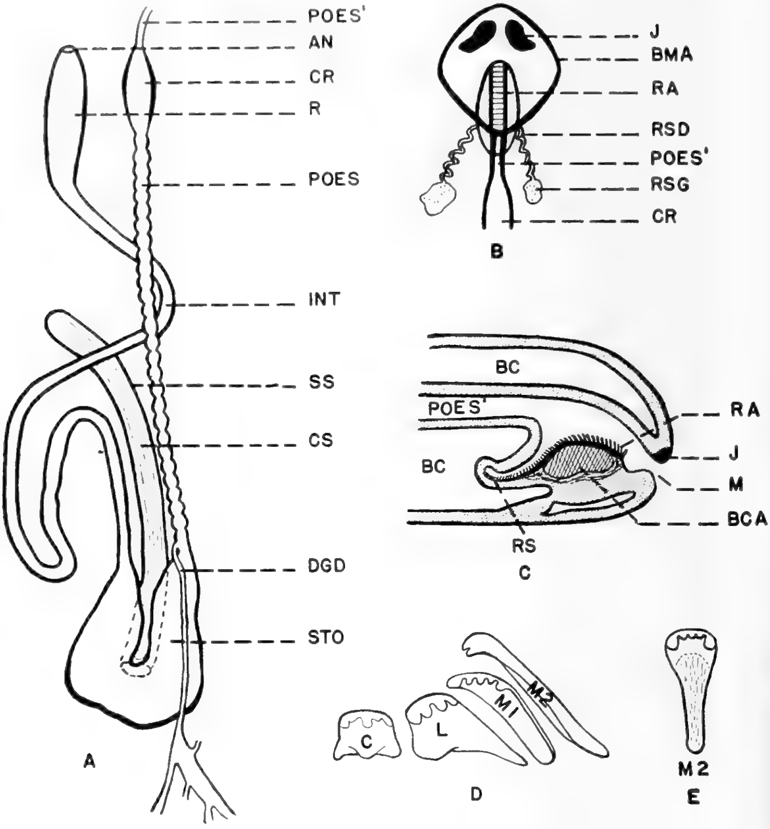

PLATE 40

a. Ventral view of the digestive system, diagramatic.

b. Dorsal view of the anterior end of the digestive tract and associated structures.

c. Longitudinal diagram through the buccal mass to show the radula and buccal muscle relation.

d. Diagram of radular teeth showing their arrangement in a single transverse row of the radula.

e. Sketch of the second marginal tooth to show relation of cusped surface to tooth body as compared to other radular teeth.

The intestine is 34.2 mm. long. It proceeds anteriorly from the stomach, then curves posteriorly, and then proceeds anteriorly along the dorsal edge and into the renal cavity. It proceeds anteriorly from the renal cavity, then turns dorsally toward the right side to end in a spout-like anus on the ventro-anterior margin of the mantle collar. The intestine, shortly after it leaves the cavity of the kidney, becomes enlarged as the pellet-molding region; this is followed by the bulbous rectum.

A cross-section of the intestine reveals three intestinal layers (Plate 41-D): 1) an inner layer lining the intestinal lumen composed of pseudostratified ciliated columnar epithelial cells quite similar to those of the style sac; 2) a middle layer of longitudinal muscle; and 3) an external tunic composed of an inner layer of circular muscle, and an outer serosa of connective tissue. An outer encapsulating epithelium covers these three layers.

Two specialized areas of the intestine are the typhlosole and the pellet-molding area. The typhlosole is formed by a longitudinal infolding of the intestinal wall. It projects 0.13 mm. into the lumen of the intestine. It begins just posterior to the stomach-intestine juncture, and extends to the beginning of the pellet-molding area. There is some increase in the width of the typhlosole from its anterior beginning to its posterior limit. A network of connective tissue fibers and scattered smooth muscle fibers fills the depression dorsal to the typhlosole.

The pellet-molding area varies little histologically, except that there is a marked increase in the circular muscle layer. The epithelial lining of the pellet area is thickly annulate. These uniform annulations are blackish-brown, and are easily visible on the dorsal surface of the visceral mass.

LIST OF ABREVIATIONS USED IN ILLUSTRATIONS:

A — apex
AN — anus
AP — aperture
BM — basement membrane
BC — body cavity
BCA — buccal cartilage
BMA — buccal mass
BW — body whorl
CE — columnar epithelium
CL — columella
CM — columellar muscle
CR — crop
CS — crystalline style
CT — connective tissue capsule
DGD — digestive gland duct
E — eye
GE — gastric epithelial cell
IL — inner lip

INT — intestine
ITS — intertubular space
J — jaw
K — kidney
L — lateral tooth
LI — liver
LM — longitudinal muscle
M — mouth
M1 — first marginal tooth
M2 — second marginal tooth
MC — mantle collar
MESP — mesopodium
METP — metapodium
O — operculum
OL — outer lip
OV — ovary
PE — pseudostratified ciliated columnar epithelium
POES — postoesophagus
POES — preoesophagus
PROP — propodium
R — rectum
RA — radula
RS — radula sac
RSD — right salivary duct
RSG — right salivary gland
S — suture
SL — serosal layer
SM — submucosal layer
SS — style sac
STO — stomach
TEN — tentacle
TL — tubular lumen
TYPH — typhlosole
V — varix

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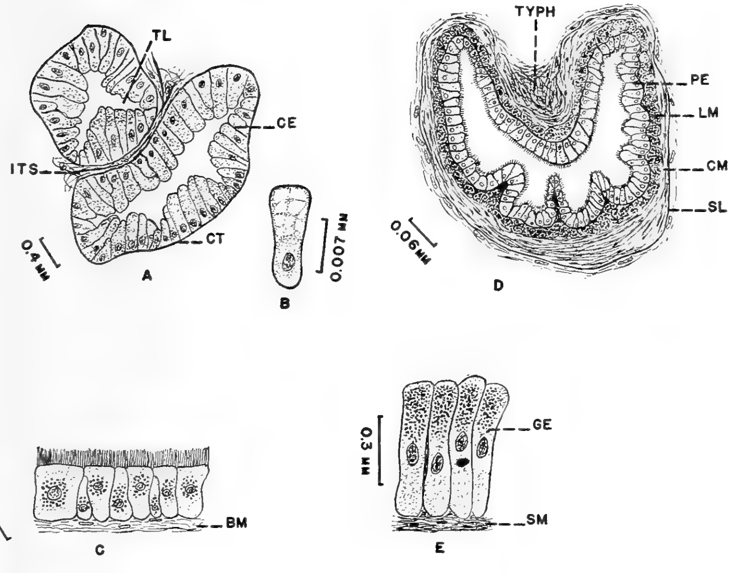


PLATE 41

a. Histological sketch of tubular structure of the liver showing cell makeup, and intertubular tissue.
b. Structure of a single liver cell.
c. Pseudostratified ciliated columnar epithelium lining the style sac.
d. Cross-sectional view of the intestine at the level of the kidney. Illustrates the typhlosole, and intestinal cellular structure.
e. Gastric epithelial cells lining the stomach.

NOTES ON THE EARLY STAGES OF *FERALIA FEBRUALIS* GROTE

By John Adams Comstock

This beautiful noctuid moth is one of the native California species of which very little has been recorded concerning its life history.

The author, in association with the late Charles M. Dammers described and illustrated the mature larva in 1945[1] from examples collected on *Sambucus* (Elderberry), and S. E. Crumb, in 1956[2] published notes on the larva, from preserved material collected by H. H. Keifer, who reported the food plants as *Cercocarpus betuloides* Nutt., and Oak (*Quercus douglasii* H. & A.).

On April 5, 1957 I received from my valued correspondent, Noel McFarland, a number of eggs of this species. These were obtained from a female collected at a point on the Oak Pass Road, six miles north of Beverly Hills, Santa Monica Mountains, California, at an elevation of 1100 feet. They hatched April 6 and 7, 1957.

Several examples were reared to maturity, which made possible the following notes:

EGG: .95 mm. wide × .65 mm. tall; conoidal, with a well rounded top and slightly convex base. The color was translucent light green, assuming a yellowish shade prior to hatching.

There are approximately 25 to 30 longitudinal (vertical) ridges running from base to, or nearly to the micropyle. As with most eggs of this character, several of these ridges stop short of the micropyle, or fuse with the nearest neighbor.

The edge of each rib is topped by a series of nodules. In line with each nodule there is a fine transverse ridge connecting with the nodules on neighboring ridges.

The micropyle is not depressed, and is poorly defined.

The egg is illustrated on Plate 42, figure A.

[1]Bull. So. Calif. Acad. Sci. 43 (3), 116-118, 1944 (1945).
[2]The Larvae of the Phalaenidae. U.S.D.A. Technical Bull. No. 1135, pp

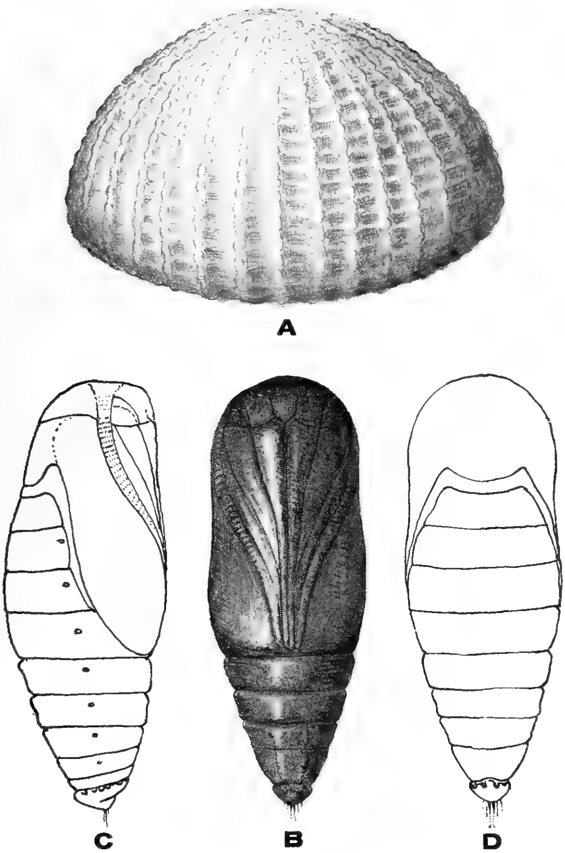


PLATE 42

Egg and Pupa of *Feralia februalis* Grote.

Fig. A. Egg, side view, slightly tipped forward to show micropyle. Enlarged × 60

Fig. B. Pupa, ventral aspect. Fig. C. Pupa, lateral aspect.

Fig. D. Pupa, dorsal aspect. Enlarged × 4.

Reproduced from painting by the author.

LARVA.

First instar. Length, 2 mm. Head width, .52 mm.

Head, bright lemon-yellow. A number of short dark setæ are scattered over the face, each arising from a minute black papillus. Mouth parts, lemon yellow; ocelli, black. The head is considerably wider than the first segment.

The body is a uniform translucent light green, except for a tinge of yellow on the first thoracic segment. It is covered with several longitudinal rows of conspicuous black papillæ, each bearing a short black seta.

The legs and prolegs are concolorous with the body.

Ecdysis occurred April 13, 1957.

Second instar. The larva was not measured at the beginning of the instar. Shortly before moulting it was 7 mm. long, and the width of head was .75 mm., which was narrower than the first thoracic segment. Its color was a uniform light green. The ocelli were black.

The body ground color was deep green. On this there were superimpŏsed a prominent longitudinal middorsal white band, a narrower dorso-lateral white stripe, and a wide stigmatal white band.

54 and 56.

A prominent dorsal 'hump' was present in the caudal area.

The setæ were minute and black, each one arising from a small black papillus. The legs and prolegs were concolorous with the body.

Ecdysis occurred April 17, 1957.

Third instar. Length, 7 mm. Head width, 1.25 mm.

The color is much as in the last instar, except that the setæ now arise from a white base, the longitudinal lines are more prominent, and the stigmatal band is slightly tinged with yellow. The caudal hump is more prominent, and the white lines on it are as described by Crumb (1.c.), for the final instar. The crochets are yellow.

Ecdysis occurred April 22, 1957.

Fourth instar. Length, 11 mm. Head width, 2 mm.

The appearance of the larva is essentially that of the preceding instar. The stigmata are yellow, and do not have black rims.

Ecdysis occurred May 2, 1957.

Fifth instar. Length, 19 mm. Head width, 3.3 mm.

The larva differs from the preceding instar only in the following particulars: The yellow stigmatal band is edged superiorly by an orange stripe, which is wide on the first three segments, and very narrow or partly obsolescent as far caudally as the tenth segment, where it pinches out.

The antennæ are bright yellow proximally, and brown on the tips. The mouth parts are edged with brown. The legs are dark brown.

By May 13, 1957 all had gone underground, and by June 5, all had pupated.

PUPA. Length 15 mm. Greatest width through center, 6 mm.

The surface is smooth and glistening, but on magnification shows fine rugosities or punctations on most of the areas.

The color is very dark brown, with a slight reddish tinge on the wings, and black shading on the head and cremaster.

The head is well rounded, the eyes inconspicuous, and the cauda ends in a low cone with a series of pits around the base. The cremaster is tipped by a pair of straight-shafted small spicules with slightly recurved tips. The bases of the cremasteric shafts are dark brown, and the ends are red. Four or more shorter and more delicate spicules are grouped around the central pair, all of which are red-brown.

The antennæ and maxillæ reach nearly to the margins of the wings. The spiracles are small and inconspicuous. The pupa is figured on Plate 42, figs. B, C, D.

Emergence of the imagines occurred in March and April, 1958.

As its name indicates, the species is an early flier. Examples in our collection were taken at light between the months of January and early April.

Collectors in southern California have reported it as feeding only on *Sambucus*. Keifer's record from Sacramento, "on oak and *Cercocarpus*" (see Crumb, 1.c.) may well be correct. W. T. M. Forbes, 1954[3] records a related eastern species (*Feralia comstocki*) as feeding on conifers.

[3]Lepid. of N.Y. and Neighboring States, Cornell Univ. Agr. Exp. Sta. Memoir 329.

A BRIEF NOTE ON THE PUPA OF MELITAEA POLA BOISDUVAL

(Lepidoptera: Nymphalidæ)

Early in 1931 the late John L. Sperry, and Grace H. Sperry were actively carrying on studies in the life histories of southern California's butterflies. One result of this effort was the publication in Volume 31, Part 1 of this Bulletin, of the larva of *Melitæa pola* Bdv., from material gathered in Rocky Mountain National Park, Colorado.

John Sperry was urged at the time to make a drawing, and prepare notes on the pupa.

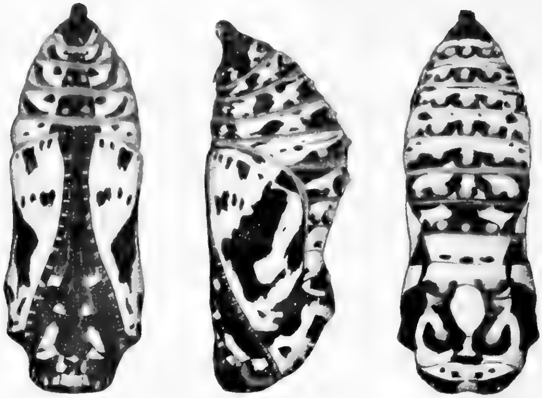


PLATE 43
Pupa of *Melitaea pola* Boisduval, enlarged ×4.
Reproduced from painting by John L. Sperry.

This he apparently did at the time, but neglected to submit them for publication. Possibly this oversight was the result of a waning interest in the butterflies along with an all-absorbing interest in the geometrid moths.

At a much later date, and subsequent to the death of Grace Sperry, the colored drawing of the chrysalis of *M. pola* was turned over to me, minus the description, which had become misplaced.

John Sperry was always over-modest and apologetic respecting his art efforts. There was no justification for this feeling, as he was an excellent draftsman, and had a fine sense of color. The painting which he made, together with a marginal note, gives the essentials for an adequate description of the

PUPA OF *Melitæa pola* Bdv.

Length, 13 mm. Greatest width through shoulders, 5 mm.

Ground color, lustrous white; heavily overlaid with numerous dots, dashes and irrorated lines of black, disposed as shown in the illustration, Plate 43.

On the dorsal surface there are several longitudinal rows of short round papillæ. One row is placed middorsally, extending from the third abdominal to the caudal segment. A second row parallels this dorso-laterally, and a third runs laterally.

All of these papillæ are colored orange-yellow. Four similar papillæ occur on the thorax.

Sperry's drawing was made July 20, 1931. There is no record of the time of emergence of the imago.

John A. Comstock

CHECKLIST OF THE ALLECULID GENUS HYMENORUS MULS. IN NORTH AMERICA, INCLUDING MEXICO

(Notes on North American Coleoptera, No. 4)

By CHARLES S. PAPP[1]

The members of the genus *Hymenorus* Mulsant (Mém. Acad. Lyon, I, 1851, p. 201) are small oblong or oval species, having the last joint of maxillary palpi in the form of a right-angled triangle with the apex and outer sides subequal in length. The lobes of the tarsal joints are less developed than in *Allecula*, the front and middle tarsi never having more than two joints lobed, and the hind tarsi with but one.

Since the publishing of Borchmann's Alleculidæ in the Coleopterorum Catalogus (Berlin, 1910) 57 new species have been described from North America, including México. With these new species included, the genus now stands as follows, arranged alphabetically:

HYMENORUS Muls.

alienus Fall .... Ariz.
apacheanus Csy. .... Ariz.
arkansanus Fall .... Ark.
atratus Fall .... Ariz.
badinus Champ. .... México
bitumescens Fall .... Ariz.
brevicollis Champ. .... México
brevipes Champ. .... México
brevis Fall .... Ariz.
canaliculatus Champ. .... México
caducus Fall .... Ala., Fla.
capensis Fall .... Calif.
cassus Fall .... L. Calif.
castaneus Champ. .... México
caurinus Fall .... B.C.
communis LeC. .... N.C., Fla.
confertus LeC. .... Calif., (Ariz?)
conformis Fall .... Texas
conicicollis Fall .... Ga.
convexus Csy. .... Texas, Fla.
corticarioides Champ. .... México
crinitus Fall .... Ariz.
curticollis Csy. .... Iowa
densus LeC. .... O., Fla., Tex., Ind.
deplanatus Champ. .... México
= gemellus Csy. .... Ariz.
depressus Champ. .... Ariz., México
dichrous Blatchl. .... Fla.
difficilis Csy. .... N.Y.
digressus Fall .... S. Calif.
discrepans Csy. .... Calif.
discretus Csy. .... Mass., N.Y., Fla., Ind.
dissensus Csy. .... Texas
distinctus Fall .... Miss., Ala., Fla.
disparatus Fall .... Texas
dorsalis Schw. .... Fla.
=subalensis Blatchl.
dubius Fall .... Ala.
durangoensis Champ. .... México
ebeninus Fall .... Calif.
exiguus Csy. .... Texas
exilis Fall .... Ariz.
facetus Fall. .... L. Calif.
flohri Champ. .... México
floridanus Csy. .... Fla.
forreri Champ. .... México
fuscipennis Fall .... Fla.
fusculus Csy. .... Calif.
fuscicornis Csy. .... Calif.
grandicollis Champ. .... México, S. Calif., Ariz.
granulatus Blatchl. .... Fla.
helvinus Csy. .... Texas
heteropygus Fall .... Fla., Texas

[1]University of California, Citrus Experiment Station, Department of Entomology, Riverside, Calif.

hispidulus Champ. ....México
horrescens Fall ..........................N.M.
humeralis LeC. ....Ky.
illusus Fall ....Ala.
inaequalis Csy. ....Ariz.
incertus Fall ....Ariz.
idoneus Fall ....Ariz.
igualensis Champ. ....México
indutus Csy. ....Texas, Ariz.
infuscatus Csy. ....Calif.
inopiatus Fall ....Ga., Fla.
inquilinus Csy. ....Calif.
intermedius Csy. ....Texas
inutilis Fall ....Nev., Ut., N.M.
irritus Fall ....Calif., Ariz.
jacobinus Fall ....S. Calif.
laticollis Champ. ....México
longicollis Champ. ....México
liebecki Fall ....Ariz.
macilentus Fall ..........................N.M.
melsheimeri Csy. ....Mich., Ind.
milleporus Fall ....Ariz.
molestus Fall ....Pa.
montivagus Fall ....S. Calif.
nevadensis Fall ....Nev.
niger Melsh. ....Canada, Fla., Ind., Texas
nitidipennis Csy. ....Ariz.
oblivus Fall ....Tex.
obscurus Say .....................N.Y., Fla., Ind., Texas
occidentalis Champ. ..Centr. Amer., Ariz., Texas, Ind.
pallidus Champ. ....México
papagonis Fall ....Ariz.
parvicollis Champ. ....México
parvus Fall ....L. Calif.
perforatus Csy. ....Ind., N.C., Pa.
picipennis Csy. ....Mich.
pilosus Melsh. ....Mass., Mich., Virg., Ind.
=obesus Csy.
planus Horn ....L. Calif.
porosicornis Csy. ....Texas
prolixus Csy. ................N.M., Ariz.
protibialis Fall ....S. Calif.
punctatissimus LeC. ....Calif., Ariz.
=macer Csy.
punctulatus LeC. ....Calif.
quadricollis Fall ....Texas
quietus Fall ....Mo.
rotundicollis Csy. ....Ariz.
rufescens Champ. ......México, Ariz.
ruficollis Champ. ....México
rufovalis Fall ....Ariz.
segnis Champ. ....México
semirufus Fall ....Fla.
seriatus Csy. ....Ariz.
significans Fall ....Texas
simidus Fall ....Texas
similis Champ. ....México
sinuatus Fall ..............................B.C.
sobrinus Csy. ....Fla.
spinifer Horn ....Ariz., Calif.
tenellus Csy. ....Fla.
=elberatae Blatchl.
tenuistriatus Fall ....Ala., N.C.
testaceus Csy. ....Ariz.
texensis Fall ....Texas
thoracicus Fall ....S. Calif.
torridus Champ. ....México
trivialis Fall ....L. Calif.
tritus Fall ....Ariz.
ulomoides Fall ....S. Calif.
uniseriatus Csy. ....Calif.
vigilax Fall ....Ariz.
villosus Champ. ....México

The occurrence of the following species in México is very questionable, although they may possibly occur in the southern part of the republic.

americanus Champ. ....C. Amer.
colonoides Champ. ....C. Amer.
emmenastoides Champ. ....C. Amer.
foveiventris Champ. ....Guatem.
guatemalensis Champ. ....Guatem.
maritimus Champ. ....Guatem.
oculatus Champ. ....C. Amer.
pini Champ. ....Guatem.
sordidus Champ. ....C. Amer.
tarsalis Champ. ....Guatem.
tibialis Champ. ....Guatem.

The genus, one of the largest of Alleculid beetles, is represented in Europe and Asia by a very few species. It is not represented in Africa, Australia, Indonesia and the Pacific Islands, and, surprisingly, not in South America.

A NEW GENUS OF APTEROUS ARADID FROM THE PHILIPPINES
(Hemiptera: Aradidae)

By CARL J. DRAKE,
Smithsonian Institution, Washington, D.C.

In a recent paper the author (Drake 1957. Proc. Ent. Soc. Wash. 59(4): 169-171) described a new species of an apterous aradid obtained from the mouth and stomach of a frog collected on Julu Island in the Sulu Archipelago. As the aradids were in almost perfect state of preservation, it was evident that the frog was licking them into its mouth with its extensile sticky tongue at the time of capture and preservation. The aradids were found several months later during a study of the feeding habits of frogs.

The treatise of the apterous aradids of the Americas by Drake and Kormilev (1958, Ann. Ent. Soc. Amer., 51(3): 241-247, 2 figs.) shows that the Philippine aradid is atypical of the genus *Acaricoris* Harris & Drake (1944) and that a new genus is needed for its reception.

Ainocoris, new gen.
(Plate 44)

Small, obovate, narrowest in front, widest near middle of abdomen, depressed dorsally, with dorsal surface sculptured but without large protuberances and high elevation or deep depressions. Head subquadrate, lateral sides with tubercule behind each eye, thence rapidly narrowed to neck; eyes excerted, remotely removed from fore margin of pronotum; juga surpassing tylus, with their short, apical projections divergent; neck short. Antennæ with segment I swollen, longest, II shortest, III a little longer than IV. Labial sulcus short, wide, not quite reaching to neck, the labium nearly extending to apex of sulcus.

Thorax slightly wider in front than transocular width, with the three divisions fused solidly together and the metanotum also fused with the first two adbominal segments, with lateral sides granulate and converging anteriorly, sutures separating mesonotum from pronotum and from metanotum distinctly indicated on each side of the wide, smooth, longitudinal, median part but not at all visible in the latter; collar short, narrow, with an encircling furrow, deeply inserted into pronotum, with the outer parts of front margin (one each side of collar) projecting anteriorly slightly beyond collar; median longitudinal part of meso- and metanotum very large, pentagonal, depressed, slightly convex, smooth, shining, shaped as in figure 1. Orifice and channel of metathoracic stink glands scarcely perceptible. Spiracles all lateral, II through VII visible from above, VIII placed on the end of a posteriorly directed tubercle, also visible from dorsal aspect.

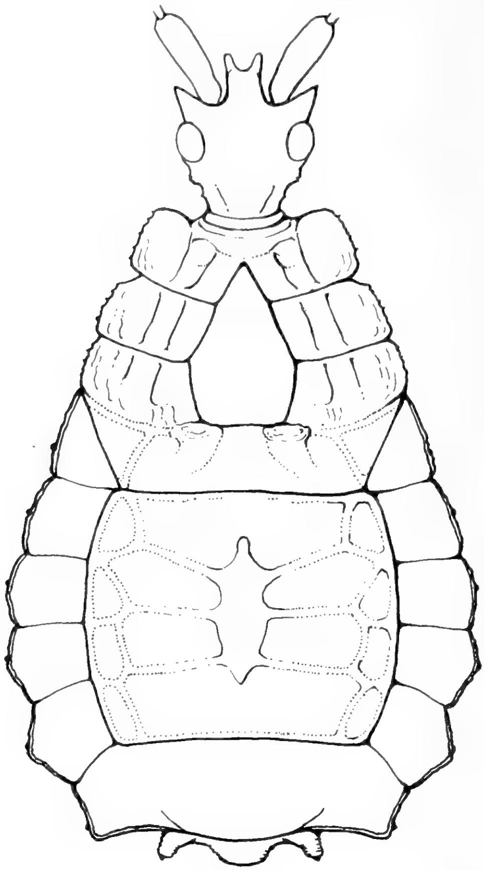


PLATE 44
Ainocoris dybasi (Drake) (paratype).

Abdomen with tergite III through VII fused solidly together into one plate, with median carinæ and sculpturing as indicated in the figure. Legs moderately long, femora very little swollen.

Type species *Ainocoris dybasi* (Drake) (= *Acaricoris dybasi* Drake 1957), Plate 44.

This genus belongs to the tribe Carventini Usinger 1950. It can be separated from *Acaricoris* by the very large, depressed, smooth, polished, pentagonal area (Plate 44) in the median longitudinal part of thoracic division. The collar is also deeply inserted, lateral sides of the thorax granulate, and the three divisions plainly indicated.

THREE NEW SPECIES OF YPSOTINGIS (HEMIPTERA: TINGIDAE)*

By CARL J. DRAKE,
Smithsonian Institute, Washington, D. C.

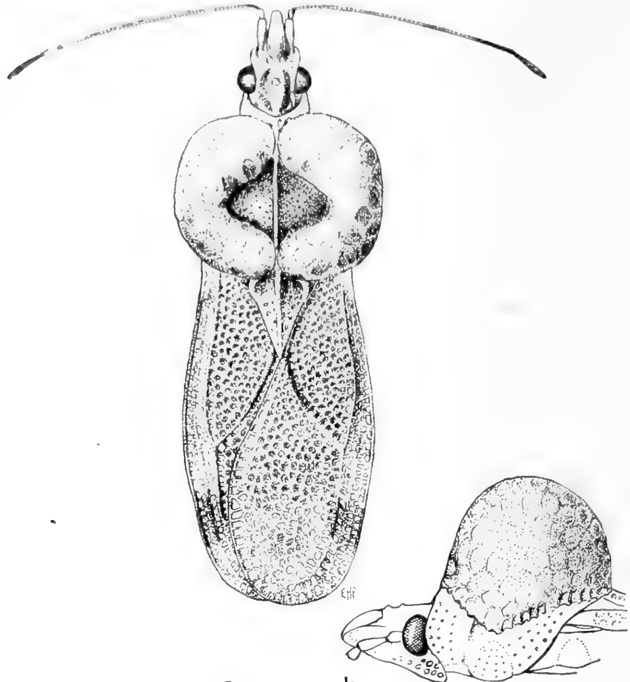
The genus *Ypsotingis* Drake (1947, Notes d'Ent. chinoise 11(7): 229) was erected to hold *Y. sideris*, an undescribed species from Indochina. Since then, two other species also have been characterized from the Oriental Region. This paper described three new members of the genus, two from Borneo and the other from the Philippines. A list of species of *Ypsotingis* is also included. The illustrations were drawn by Mrs. Richard Froeschner. Types of the new species are in the Drake Collection (U.S.N.M.).

Ypsotingis bakeri, sp. nov.
(Plate 45, a & b)

Head long, extending anteriorly beyond eyes nearly three times the length of an eye, black, with median longitudinal ridge and a narrow stripe next to inner side of each eye yellowish, apex beyond anterior spines infuscate, armed with short, blunt, tubercle-like spines; hind pair of spines short and appressed, median spine between eyes and anterior pair in the form of short, upright tubercles; bucculæ testaceous long, rather narrow, tapering anteriorly, parallel, open in front, with apices not extending anteriorly as far as apex of head. Antennæ long, very slender, pale brown, indistinctly pubescent, with first two segments short, stout, the tips of second scarcely attaining apex of head, third very long and fourth short and also slender. Labium extraordinarily long, reaching to first genital segment; sulcus rather deep, extending on abdomen to apex of last ventrite, with the laminate sides on sterna foliaceous, testaceous and uniseriate. Legs long, slender, with tarsi also slender.

Pronotum deep brown, sharply punctate, largely concealed by enormous paranota, tricarinate; median carina fairly thick, long, moderately elevated, composed of one row of fairly large areolæ; collar raised, inflated at middle so as to form a small hood; lateral carinæ curved inward at base of paranota, thence anteriorly not visible under reflexed paranota; paranota enormous, testaceous with some cells infuscate, reflexed upright, shaped as in Plate 45. Collar, carinæ and triangular process of pronotum testaceous with some brownish. Elytra with areas as in Plate 46-a, brown, with

*Supported in part by N.S.F. Grant No. 04095.



a b

PLATE 45
Ypsotingis bakeri Drake, n. sp. (holotype).

transverse band in costal area beyond discoidal and sutural areas (partly) testaceous; costal area mostly uniseriate, biseriate beyond discoidal area; subcostal area largely biseriate; other areas plainly visible in figure. Hypocostal laminæ uniseriate. Orifice and channel of metathoracic stink gland distinct. Length 6.00 mm., width 1.90 mm. Female unknown.

Holotype (male), Sandakan, Borneo, C. F. Baker.

The narrow costal areas and shape of paranota separates at once this species from the new species below, also the other three described species.

Ypsotingis luzonana, sp. nov.

(Plate 46, **a** & **b**)

Head long, produced anteriorly in front of eyes nearly three times the length of an eye, brown with a pair of basal longitudinal stripes extending between eyes; eyes transverse, black; buccula testaceous, long, wide, parallel, open in front, with apices

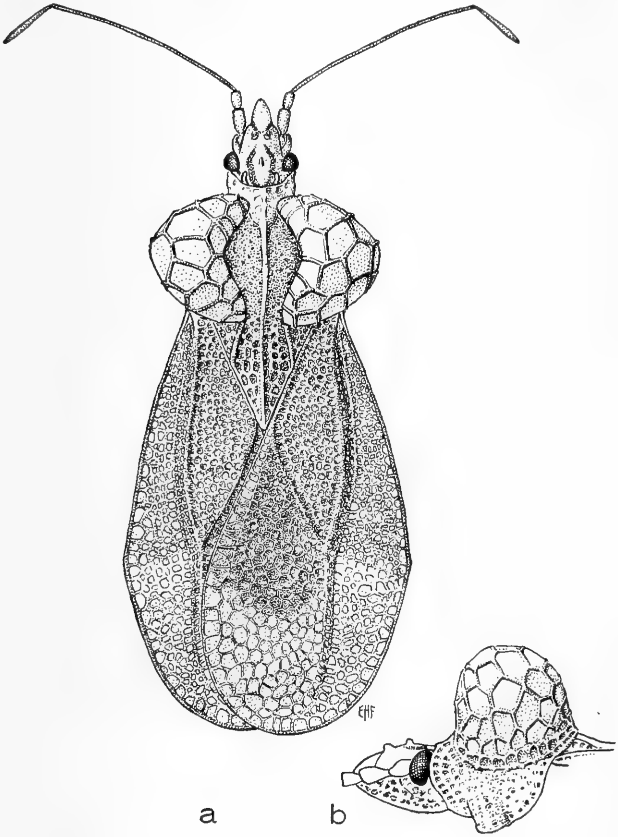


PLATE 46

Ypsotingis luzonana Drake, n. sp. (holotype).

not extending anteriorly as far as apex of head, three areolæ deep in front and four behind. Labium very long, brownish testaceous, with apex reaching onto sixth ventrite; sulcus with moderately wide and uniseriate laminæ on sterna, extended as an indistinct furrow on basal part of abdomen. Antennæ very slender, long, indistinctly pubescent, with first two segments short and apices of second not extending beyond tip of head; segment III very long, very slender; IV short, also slender. Orifice and canal of metathoracic stink glands visible on mesopleura. Hypocostal laminæ long, uniseriate.

Pronotum distinctly punctate, largely concealed (not including disc and median longitudinal part) by the enormously developed paranota, which are somewhat shell-like and reflexed upward (Plate 46;) median carina moderately elevated, uniseriate; lateral carinæ curved inward behind paranota and then not visible beneath paranota; collar areolate, inflated behind at middle so as to form a small hood; paranota enormously developed, reflexed upright, as in Plate 46. Elytra with areas formed as in Plate 46, brown with a transverse, testaceous band in costal area behind apex of discoidal area; costal area very wide, widest at pale band, there six or seven areolæ deep; subcostal area two areolæ deep; discoidal area large, six or seven areolæ deep in widest part, extending beyond middle of elytra. Paranota, collar, Carinæ and sides of thorax largely testaceous. Abdomen beneath brownish flavous. Legs long, slender, brownish. Length 5.00 mm., width 2.25 mm. (abdomen.)

Holotype (male), Mt. Makiling, and *allotype* (female), Mt. Banahoa, Luzon, P. I., C. F. Baker.

The allotype (Plate 46) is illustrated. Separated from *Y. bakeri*, n. sp. by the much narrower costal area and shape of the elytra. In *Y. vicinatis* Drake from Java, the antennæ are a little stouter, veinlets slightly coarser, and the lateral carinæ of pronotum are visible from dorsal aspect beneath the reflexed paranota.

Ypsotingis bornea, sp. nov.

Oblong, widest behind the middle, dark brown with paranota dark brownish fuscous and veinlets lighter; collar testaceous, triangular process of pronotum pale; elytra with pale transverse band of costal area slightly behind apex of discoidal area; sutural area slightly tinged with testaceous. Appendages brownish. Body beneath brownish flavous with sternal laminæ of labial sulcus testaceous. Length 3.85 mm., width 1.40 mm. (widest part of elytra.)

Head long, produced nearly three times the length of an eye in front of eyes, armed with five spines; hind pair short, blunt, appressed, the other three barely represented by rounded tubercles; bucculæ brownish testaceous, composed mostly of two rows of large areolæ, three in posterior part, with apices separated and not quite attaining apex of head. Labium brown, extremely long with tip reaching to last ventrite; laminæ composed of one row of large cells, without distinct sulcus on venter. Antennæ

long, slightly thicker than in other species described above; segments I and II short, swollen, the latter barely surpassing apex of head. Metapleura with orifice and channel of stink glands distinct. Hypocostal laminæ composed of one row of moderately large areolæ. Legs long, very slender, indistinctly and sparsely furnished with tiny, golden pubescence.

Pronotum almost entirely concealed by very large, subglobose, reflexed upright paranota, with only collar, median carina and posterior process visible; collar areolæ, raised, inflated at middle behind so as to form a small hood; median carina composed of one row of moderately large areolæ; lateral carinæ uniserate, strongly curved inward behind paranota, then completely hidden beneath the reflexed paranota; paranota extremely large, subglobose, slightly flattened on top, with margins within nearly in contact above median carina, longer than high (70:60.) Elytra widest behind apices of dicoidal areas, with apices jointly rounded in repose; sutural area widened apical, with five or six rows of areolæ in widest part across apices of discoidal areas; subcostal area nearly vertical, biseriate; discoidal area large, extending beyond middle of elytra, bounded by a prominent vein, acutely, angulate at both ends, widest opposite apex of pronotal projection, there six areolæ deep; sutural area on same horizontal level as discoidal, areolation also the same.

HOLOTYPE (female), Sandakan, Borneo, C. F. Baker. Male unknown.

Separated from the other new species above by the more reflexed and dark fuscous paranota and the slightly stouter antennæ. The paranota also distinguishes it at once from other Oriental species.

LIST OF SPECIES

Genus *Ypsotingis* Drake 1947

Type species, *Ypsotingis sideris* Drake

1. *bakeri* Drake, n. sp. .... Philippines.
2. *bornea* Drake, n. sp. .... Borneo.
3. *luzonana* Drake, n. sp. .... Philippines.
4. *sideris* Drake 1947 .... Indochina.
5. *tonkinana* Drake and Maa 1955 .... Indochina
6. *vicinatis* Drake 1948 .... Java.

A SYNOPSIS OF THE GENUS BELOSTOMA LATREILLE, OF AMERICA NORTH OF MEXICO, WITH THE DESCRIPTION OF A NEW SPECIES

(Hemiptera; Belostomatidae)

By Arnold S. Menke*

The genus *Belostoma* is the largest in number of species in the family Belostomatidæ. It is confined to the Western Hemisphere being found in North America, Central America, South America, and the West Indies. It is the aim of the author to present a key to the United States species and present techniques which will aid further work in the genus and family. The identification of the species in this genus has always been difficult because of the similarity of many of its members. Indeed, the family as a whole is a morphologically monotonous group showing few good characters for separation of the species. Early workers in the group failed to give adequate means of identification, basing their descriptions mainly on color and size. These two characters vary considerably. This fact has not always been readily apparent to workers who, in most cases, had small series of specimens. Misidentifications by some workers have filled the literature with erroneous or questionable records. Study by American workers in this genus, and indeed in the whole family, is complicated by the fact that most of the types are in European museums. Since many of the early original descriptions were very superficial, it will be difficult for workers to establish names correctly until the types are seen.

ACKNOWLEDGEMENTS

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TAXONOMIC CHARACTERS

Color cannot be relied upon without the aid of additional morphological characters. The appearance of the bug is often dependent on the drying effects of the underlying tissues. Specimens kept in alcohol for long periods of time may be atypically colored. Grease and dirt also effect the color of the body. Size is variable in some species and cannot be relied upon without other substantiating characters. The antennæ which have been used in other genera with some success, do not show any differences in the species I have studied. Whether or not the base of the clypeus passes a line drawn between the anterior angles of the eyes, has been used as a character by some. I have found that if the head is in proper position with the rest of the body, that is, the dorso-ventral axis of the head perpendicular to the horizontal axis of the body, the clypeus does not pass the line in any of the United States species. If the longitudinal axis of the head is parallel with the working surface, then the clypeus does appear to pass the line in some of our species. I am of the opinion that the postion of the clypeus is an unreliable character to use, at least in our forms. The length of the proboscis compared to the length of the eye is a relatively good character but it must be supported by other distinguishing features as the proportion is not absolutely constant within a species. The comparison of the width and length of the interocular space appears to be of value mainly in South American forms. The shape and proportions of the segments of the beak are very distinctive in many species. This is best shown by illustration (fig. 9). When measuring the segments of the beak it is essential that the method used be stated. Measurements made along the anterior face do no agree with those made along the posterior face. In *B. bakeri* for example, the first segment is shorter than the second if measured on the posterior face but longer than the second if measured on the anterior face. The shape of the whole head as seen from the side is a very good distinguishing character. In some species

the proboscis is very prominent whereas in others, the head slopes rapidly downward and is not at all prominent. The shape of the pronotum is distinctive for some forms. The lateral margins may be straight or sinuate. The shape of the prosternal carina is of value in separating South American species, however, it is similar in all United States species. The form of the metasternum (metaxyphus) has been used in other genera but does not appear to present any distinctive differences in our species. Probably the most important character is the pattern and amount of hair on the ventral connexival plates. Many of the species have their own distinctive pattern of hair. It is interesting to note that the connexival hairs were overlooked by the early workers. A. L. Montandon was the first to mention it. The shape and proportions of the caudal filaments is of some value in separating species. The male genitalia have been examined in all of our species but they offer no distinct differences to separate the species. A study of the genitalia throughout the genus may reveal group characters.

TECHNIQUE

When measuring the length of the specimen, the caudal filaments should be ignored. Males can easily be separated from females. The male genital plate is acuminate at the tip while that of the female is rounded at the tip and usually bears two tufts of setæ. It is important that the specimens be free from dirt and grease, otherwise it is difficult to make out the pattern of hair on the connexivum. The reference to the connexivum here means the mesal two thirds of the ventral connexival plates. The outer third (marginal) of the plate is always glabrous. When measuring or observing the characters of the head, the insect should be held so that the longitudinal axis of the body is parallel to the working surface with the head directed to the left. The dorso-ventral axis of the head should be at right angles to the horizontal axis of the body (fig. 9). Usually the head is tilted down in relation to the body and the bug must be oriented accordingly to view it properly. The length of the proboscis in relation to the length of an eye is measured as indicated in figure 9. If the caudal filaments are not extended enough from the abdomen to discern the shape of the apical half, it will be necessary to relax the specimen and pull them out. After the abdomen has been relaxed in 5% alcohol for a few hours the filaments are

easily pulled out with gentle tugging of forceps. The caudal filaments of specimens that have been recently collected can be pulled out readily for easy observation while the bugs are still relaxed. To measure the proportions of the filaments it is necessary to remove them from the abdomen. First the abdomen must be relaxed. Then holding the bug ventral side up, insert a minuten nadeln (bent into a small hook) under the genital plate until it breaks through the membrane at the base of the plate. Move the needle from one side to the other to tear the membrane. Gently tug at each side of the genital capsule until it is removed. The caudal filaments will accompany the genital capsule when it is withdrawn. The filaments and capsule can be conveniently kept in a small vial of glycerin on the pin beneath the insect.

DESCRIPTION OF THE GENUS *Belostoma*

Belostoma Latreille, 1807, Genera Crustaceorum et Insectorum, vol. 3, p. 144. Type species *testaceo-pallidum.*

Zaitha Amyot et Serville, 1843, Histoire Naturelle des Insectes, Hemipteres, p. 430. Type species *stolli.*

Perthostoma Leidy, 1847, Jour. Acad. Nat. Sci. Phil., second series, 1: 59. Type species *testaceum.*

Oval, flattened bugs. Head triangular, proboscis prominent. Beak of 3 segments; the first two segments nearly equal in length and twice as long as the third. Antennæ four-segmented; the second and third joints with a long finger-like process; the fourth as long as the second and third. Pronotum trapezoidal, anterior margin sinuate. Clavus without veins; corium with network of veins; membrane well developed, wide. Protarsi of two segments terminated with a single claw; meso- and metatarsi three pointed, and terminated with two claws. First segment of tarsus concealed in apex of tibia. Eggs attached to hemelytra of males.

KEY TO UNITED STATES *Belostoma*

1. Size 30 mm. long or more; Texas ....
   .... *Belostoma boscii* Le Peletier and Serville 1825.
– Size 26 mm. long or less .... 2.

2. Connexival plates 2-5 completely covered with hair; patch of hair on sixth connexival plate touching genital plate, and reaching one half length of genital plate, triangular in shape (fig. 7) .... 3.

Connexival plates 2-5 never completely covered with hair, always separated from abdominal sternites by a glabrous area; patch of hair on sixth connexival plate separated from genital plate by a glabrous area, never reaching one half length of genital plate, shape various (figs. 5-6, 8) .... 5.

3. Lateral margins of pronotum concave, at least at the anterior one third (fig. 1); width of head through eyes usually less than one half width of hemelytra; base of beak arising well beyond anterior margin of eye as seen from side; proboscis equal to or slightly less than length of an eye as seen from the side (fig. 9); throughout U.S............. *Belostoma flumineum* Say 1832.

— Lateral margins of pronotum straight (rarely concave) (fig. 2); width of head through eyes nearly equal to one half width of hemelytra; base of beak arising under anterior margin of eye or slightly beyond; proboscis two thirds to three fourths the length of an eye (fig. 10) .... 4.

4. Shape of apical portion of caudal filament as in figure 4; ratio of length to width of filament within .131-.169, mean equal to .153; typically a light brown species; Louisiana to Calif. and Oregon .... *Belostoma bakeri* Montandon 1913.

— Shape of apical portion of caudal filament as in figure 3; ratio of length to width of filament within .171-.197, mean equal to .186; typically a dark brown species; Saratoga Springs, Death Valley, Calif. .... *Belostoma saratogæ* Menke, new species.

5. Hair on connexivum wide, covering two thirds or more of connexival plates four and five at widest point (figs. 6, 8); interocular space smooth, evenly convex, without depression mesad of each eye .... 6.

— Hair on connexivum narrow, covering only one third of connexival plates four and five at widest point (fig. 5); interocular space with a large shallow depression mesad of each eye; Texas .... *Belostoma fusciventre* (Dufour) 1863.

6. Glabrous area separating hair from abdominal sternites very narrow, mesal margin of hair not evidently scalloped in outline (fig. 8); 20 mm. or more in length; Eastern U.S. .... *Belostoma lutarium* (Stal) 1856.

— Glabrous area separating hair from abdominal sternites wide, mesal margin of hair scalloped in outline (fig. 6); 19 mm. or less in length; Eastern U.S... *Belostoma testaceum* (Leidy) 1843.

Belostoma boscii Le Peletier and Serville

Belostoma boscii Le Peletier and Serville, 1825, Encyclopedie Methodique, 10: 273; Montandon, 1900, Bul. Soc. Rom. Sci. Buc., 9: 271; Montandon, 1903, Bul. Soc. Rom. Sci. Buc., 12(1-2): 117-120; Kirkaldy, 1906, Trans. Amer. Ent. Soc., 32(2): 151; Kirkaldy and Bueno, 1909, Proc. Ent. Soc. Wash., 10(3-4): 190 (in part);

Barber, 1914, Bull. Amer. Mus. Nat. Hist., 33: 498; Van Duzee, 1917, Univ. Calif. Publ. Ent., 2: 468 (in part); De Carlo, 1930, Rev. Soc. Ent. Arg., 3(13): 112-113, pl. 7, figs. 27-28; De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 214, pl. 8, fig. 52; De Carlo, 1939, Rev. Soc. Ent. Arg., 10: 234; Usinger, 1956, Aquat. Ins. Calif., p. 206.

Zaitha boscii Amyot and Serville, 1843, Hist. Nat. Ins., Hemip., p. 430; Herrich-Schaffer, 1853, Die Wanz. Ins., 9: 36; Mayr, 1863, Verhandl. Kais.-Konig. Zool.-Bot. Ges. Wein, 13: 354.

Belostoma dallasi De Carlo, 1930, Rev. Soc. Ent. Arg., 3(13): 114-115, pl. 5, fig. 12.

Diplonychus anurus Herrich-Schaffer, 1848, Die Wanz. Ins., 8: 26, fig. 799.

Zaitha anurus Dufour, 1863, Ann. Soc. Ent. France, 32: 388; Mayr, 1871, Verhandl. Kais.-Konig. Zool.-Bot. Ges. Wein, 21: 408, 412-414; Uhler, 1894, Proc. Calif. Acad. Sci., 4: 191; Uhler, 1894, Proc. Zool. Soc. Lond. for 1894, p. 223; Champion, 1901, Biol. Centr. Amer., Hemip.-Het., vol 2, p. 365, pl. 22, fig. 1; Banks, 1910, Cat. Nearct. Hem. Het., Amer. Ent. Soc., p. 9.

Zaitha cupreo-micans Stal, 1854, Ofv. Svenska Vet.-Ak. Forh., 11; 240; Stal, 1862 Ent. Zeit., 23 (10-12): 461.

Zaitha subspinosa Dufour, 1863, Ann. Soc. Ent. France, 32: 387.

Zaitha stolli Dufour, 1863, Ann. Soc. Ent. France, 32: 387-388.

Zaitha bifoveatum Haldeman, 1852, Expl. Surv. Vall. Great Salt Lake Utah, App. C, p. 370, pl. 10, fig. 1.

Zaitha bifoveata Banks, 1910, Cat. Nearct. Hem. Het., Amer. Ent. Soc., p. 9.

SIZE: length, 31-35 mm.; width, 13.5-15 mm.

COMPARATIVE NOTES: This is the largest species found within our limits. Its size immediately distinguishes it. The pattern of hair on the connexivum is similar to figure 6. The beak is very long and slender. *B. bifoveatum* (Haldeman) appears to be a synonym of *B. boscii*. Haldeman's description and figure of his species fits *B. boscii* very well. *B. bifoveatum* was described from a specimen taken at Fort Gates, Texas.

DISTRIBUTION: This typically Central and South American species has been recorded from the United States many times in literature. Many of these citations are probably in error. The occurrence of this species in the United States is probably limited to certain areas of states bordering on Mexico. I have seen only one specimen from the U.S. It is from the extreme southern part of Texas. I have specimens from as far north in Mexico as Hermosillo, Sonora; and San Ignacio, Baja California. It is probable that intensive collecting along the border will produce additional records of this species for the states.

SPECIMEN SEEN (U.S.):

Texas: McAllen, Feb. 20, 1932, L. D. Tuthill, 1 ♂ (UK).

Belostoma flumineum Say
(Figs. 1, 7, 9)

Belostoma fluminea Say, 1832, Descriptions of New Species of Heteropterous Hemiptera of North America, p. 32 (Fitch reprint: 1858, Trans. N. Y. State Agri. Soc., 17: 809); Montandon, 1903, Bul. Soc. Rom. Sci. Buc., 12: 113; Bueno, 1906, Can. Ent., 38: 189-197 (life hist.); Smith, 1910, Ann. Rept. N. J. State Mus., p. 168; Van Duzee, 1916, Checkl. Hem. Amer., N. Y. Ent. Soc., p. 52; Osborn and Drake, 1922, Tech. Publ. N. Y. State Coll. For., no. 16, p. 86, figs. 34, 36.

Zaitha fluminea, Dufour, 1863, Ann. Soc. Ent. France, 32: 388; Mayr, 1871, Verhandl. Kais.-Konig. Zool.-Bot. Ges. Wein, 21: 409, 416; Walker, 1873, Cat. Hem. Het. Brit. Mus., pt. 8, p. 179; Uhler, 1875, Bull. U. S. Geol. Geog. Surv. Terr., (2), 1: 338, pl. 21, fig. 42; Uhler, 1878, Proc. Bost. Soc. Nat. Hist., 19: 441; Uhler, 1884, The Standard Nat. Hist., vol. 2, p. 257; Provancher, 1886, Pet. Faune Ent. Can., vol. 3, p. 198, pl. 4, fig. 6; Uhler, 1886, Checkl. Hem. Het. No. Amer., Brookl. Ent. Soc., p. 28; Van Duzee, 1894, Bull. Buff. Soc. Nat. Sci., 5: 185; Banks, 1910, Cat. Nearct. Hem. Het., Amer. Ent. Soc., p. 9.

Belostoma flumineum Bueno, 1905, Jour. N. Y. Ent. Soc., 13: 44; Bueno and Brimley, 1907, Ent. News, 18: 435; Bueno, 1908, Jour. N. Y. Ent. Soc., 16: 237; Kirkaldy and Bueno, 1909, Proc. Ent. Soc. Wash., 10: 191; Montandon, 1909, Bul. Soc. Rom. Sti. Buc., 18: 187-188; Severin, 1911, Jour. N. Y. Ent. Soc., 19: 99-106 (biol.); Severin, 1911, Behavior Monog., 1: 1-44 (biol.); Bueno, 1912, Can. Ent., 44: 213; Barber, 1914, Bull. Amer. Mus. Nat. Hist., 33: 498 (doubtful loc.); Parshley, 1914, Psyche, 21: 140; Van Duzee, 1917, Cat. Hem. Het., Univ. Cal. Publ. Ent., 2: 467-468; Hussey, 1919, Occ. Pap. Mus. Zool. Univ. Mich., no. 75, p. 21; Hungerford, 1919, Univ. Kans. Sci. Bull., 21: 144-148, col. pl. 2, fig. 9 (biol.); Britton, 1920, Conn. State Geol. Nat. Hist. Surv. Bull., no. 31, p. 66; Hussey, 1922, Occ. Pap. Mus. Zool. Univ. Mich., no. 118, p. 39; Britton, 1923, Ins. Conn., pt. 4, Conn. State Geol. Nat. Hist. Surv. Bull., no. 34, pp. 398-399, pl. 16, fig. 6; Hungerford and Beamer, 1925, Ent. News, 36: 298-299; Hungerford, 1925, Psyche, 32: 91, pl. 2, fig. 1, Blatchley, 1926, Het. East. No. Amer., pp. 1046-1047; Leonard, 1928, Corn. Univ. Agri. Exp. Sta., Mem. 101, p. 140; De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 232-233, pl. 7, fig. 71; Brimley, 1938, Insects No. Caro., No. Caro. Dept. Agri., p. 84; Hussey and Herring, 1950, Fla. Ent., 33: 154-156 (var. *immaculata* Leidy); Ellis, 1952, Amer. Midl. Nat., 48: 326-327; Penn, 1952, Proc. Louis. Acad. Sci., 15: 51; Usinger, 1956, Aquat. Ins. Calif., p. 206.

Perthostoma aurantiacum Leidy, 1843, Jour. Acad. Nat. Sci. Phil., (2) 1: 60, 66 (incl. var. *immaculatum*).

Zaitha micrantula Gillette and Baker, 1895, Colo. Agri. Exp. Sta. Bull., no. 31, p. 63 (syn. Kirkaldy and Bueno, 1909).

SIZE: Length, 18-24 mm.; width, 8.75-11 mm.

COMPARATIVE NOTES: This species is closely related to *B. lutarium* but can be easily separated from it by the characters given in the key. Color is light brown or testaceous with darker markings only on the legs. The profemora possess on each side along the posterior margin, three small brown spots. The meso- and metafemora possess two wide brown bands on the apical half. The maculations of the legs may be darker and more pronounced or entirely absent in some specimens. The first two segments of the beak are of the same thickness, long and slender.

DATA ON DISTRIBUTION: This is probably the most common species of the genus in the United States. It is found from coast to coast. Barber's (1914) record of *flumineum* from Florida is doubtful. A misidentification of *lutarium* may have been the cause. Mr. Jon Herring of Berkeley, California, has stated in a personal conversation that his collecting throughout the state has produced no *flumineum*. I have seen specimens from the state of Chihuahua, Mexico. As far as I can determine this is the first record of *flumineum* from Mexico. I have seen specimens from the following localities:

UNITED STATES:

ARIZONA: Little Field, Sept. 6, 1953, P. D. Ashlock, 6 ♂♂, 4 ♀♀ (Ashlock); Gila Bend, Dec. 13, 1945, H. P. Chandler, 1 ♂, 1 ♀ (Usinger); Tucson, Oct. 10, 1955, F. S. Truxal and L. Martin, 1 ♀ (LACM); Phoenix, Dec. 24, 1952, H. Bullock, 1 ♂, 1 ♀ (Ashlock).

CALIFORNIA: 6 mi. S. Calipatria, Oct. 14, 1954, F. S. Truxal and L. Martin, 16 ♂♂, 11 ♀♀ (LACM); Davis, June, 1937, 1 ♂ (CAS); Fresno Co., Aug. 2, 1950, Wysong, 1 ♂ (Usinger); Garner Ranch, July 16, 1954, G. F. Auguston, 2 ♀♀ (LACM); Helm, May 12, 1954, F. S. Truxal and L. Martin, 3 ♂♂, 5 ♀♀ (LACM); Hidden Lake, Pine Canyon, Sept. 11, 1953, A Menke and L. Stange, 3 ♂♂, 5 ♀♀ (LACM); Imperial Dam, Oct. 16, 1954, F. S. Truxal and L. Martin, 2 ♂♂, 2 ♀♀ (LACM); Los Banos, May 22, 1918, E. P. Van Duzee, 1 ♀ (CAS); Madera, May 13, 1954, F. S. Truxal and L. Martin, 2 ♂♂, 8 ♀♀ (LACM); near Niland, Oct. 14, 1954, F. S. Truxal and L. Martin, 2 ♂♂, 1 ♀ (LACM); Near Planada, May 13, 1954, F. S. Truxal and L. Martin, 1 ♂, 4 ♀♀ (LACM); San Antonio Valley, Aug. 18, 1949, J. E Gillaspy, 1 ♀ (Usinger); Schwabacker Ranch, 5 mi. N. E. Madera, July 29, 1953, G. F. Auguston, 12 ♂♂, 13 ♀♀ (LACM); Tin Cistern,

Dec. 1936, 1 ♀ (CAS); Waltham Creek, 6.5 mil W. Coalinga, Aug. 29, 1952, H. B. Leech and J. W. Green, 2 ♂♂, 3 ♀♀ (CAS).

Indiana: Vigo Co., W. S. B., 1 ♀ (CAS).

Kansas: Douglas Co., Nov. 3, 1922, H. B. Hungerford, 3 ♂♂, 2 ♀♀ (CAS).

Massachusetts: Forest Hills, June 1, 1915, H. M. Parshley, 2 ♂♂, 1 ♀ (CAS); Framingham, Aug 18, 1906, C. A. Frost, 1 ♀ (CAS); Goshen, Sept. 22, 1922, H. M. Parshley, 1 ♂ (CAS); Northampton, Oct. 14, 1918, H. M. Parshley, 2 ♂♂ (CAS); Saugus, May 10, 1914, F. W Dodge, 1 ♂ (CAS).

Maine: Orono, Sept. 25, 1912, H. M. Parshley, 1 ♀ (CAS); Wales, July 10, 1913, C. A. Frost, 1 ♂ (CAS).

Michigan: Washtenaw Co., April 19, 1944, N.J. Willimovsky, 1 ♀ (CAS).

Nevada: Ash, 1940, LaR., 1 ♂ (Usinger).

New Jersey: Palisades, Sept. 7, 1 ♀ (CAS); Rahway, R., Cranford, Aug. 4, 1927, 1 ♂ (CAS).

New Mexico: Mesquite, Aug. 17, 1930, F. R. Fosberg, 6 ♂♂, 5 ♀♀ (LACM); Organ Mts., Sept. 2, Townsend, 1 ♀ (Usinger).

New York: Cold Spring Harbor, Long Island, July 20, 1920, H. M. Parshley, 1 ♀ (CAS); Ithaca, Sept. 18, 1917, E. C. Van Dyke, 1 ♂, 1 ♀ (CAS); Nepera Pk., Oct. 4, 1934, J. E. Hare, 1 ♀ (CAS).

Ohio: Columbus, Aug. 15, 1916, A. J. Basinger, 1 ♂, 1 ♀ (CAS); Hamilton Co., April 1941, 1 ♂ (Usinger); Rockridge, Aug. 30, 1916, A. J. Basinger, 1 ♂ (CAS).

Oregon: Corvallis, June 21, 1952, R. L. Usinger, 1 ♀ (Usinger).

Pennsylvainia: Columbia Crossroads, Sept. 1, 1935, R. M. Leonard, 2 ♀♀ (LACM).

Texas: Brownsville, Oct. 13, 1944, R. L. Usinger, 1 ♂ (Usinger); Worth Lake, Aug. 20, 1940, N. J. Wilimovsky, 1 ♂ (CAS).

Wisconsin: Beaver Dam, April 3, 1893, W. E. Snyder, 1 ♂ (CAS); Milwaukee, L. L. Muchmore, 3 ♂♂ (LACM).

CANADA:

Manitoba: Winnepeg, Sept. 30, 1911, J. B. Wallis, 1 ♀ (CAS).

Ontario: Ridgeway, June 8, 1895, E. P. Van Duzee, 1 ♀ (CAS).

Belostoma lutarium (Stal)
(figs. 8, 9)

Zaitha lutaria Stal, 1856, Ofvers. Kongl. Vetenskaps-Akad. Forhandl., 12: 190; Dufour, 1863, Ann. Soc. Ent. France, 32: 400; Mayr, 1871, Verhandl. Kais.-Konig. Zool.-Bot. Ges. Wein, 21: 409, 416.

Belostoma lutaria Van Duzee, 1916, Checkl. Hem. Amer., N. Y. Ent. Soc., p. 53.

Belostoma lutarium Montandon, 1909, Bul. Soc. Rom. Sti. Buc., 18: 187-188; Bueno, 1912, Can. Ent., 64: 213; Van Duzee, 1917, Univ. Calif. Publ. Ent., 2: 468; Britton, 1923, Insects Conn., pt. 4, Conn. State Geol. Nat. Hist. Surv. Bull., no. 34, p. 398, pl. 19, fig. 4; Hungerford and Beamer, 1925, Ent. News, 36: 298-299; Blatchley, 1926, Het. East. No. Amer., pp. 1047-1048; Leonard, 1928, Corn. Univ. Agri. Exp. Sta., Mem. 101, p. 140; De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 211, 233; Brimley, 1938, Ins. No. Caro., No Caro. Dept. Agri., p. 84; Britton, 1938, Conn. State Geol. Nat. Hist. Surv. Bull., no. 60, p. 31; Penn and Ellis, 1949, Fla. Ent., 32: 159; Herring, 1951, Fla. Ent., 34; 20-21, 157; Ellis, 1952, Amer. Midl. Nat., 48: 327; Penn, 1952, Proc. Louis. Acad. Sci., 15: 51-52.

Zaitha aurantiaca Walker, 1873, Cat. Hem. Het. Brit. Mus., pt. 8, p. 179 (in part).

Zaitha aurantiacum Uhler, 1886, Checkl. Hem. Het. No. Amer., Brookl. Ent. Soc., p. 28; Banks, 1910, Cat. Nearc. Hem. Het., Amer. Ent. Soc., p. 9.

Belostoma aurantiacum Bueno and Brimley, 1907, Ent. News, 18: 435; Kirkaldy and Bueno, 1909, Proc. Ent. Soc. Wash., 10: 190; Smith, 1910, Ann. Rept. N. J. State Mus., p. 168.

Size: Length, 22-25 mm.; width, 10.5-12.2 mm.

Comparative notes: This species resembles *B. flumineum* in shape and color pattern. Its average size is only slightly greater. It can be easily separated from *flumineum* by the characters given in the key. The description of *Belostoma aurantiacum* (Leidy) (as *Perthostoma*) fits *flumineum* or *lutarium* equally well. Montandon in 1909 synonymized *aurantiacum* with *flumineum* and I am following his proposal until the type is seen, if it still exists.

Data on distribution: This species ranges from Louisiana to N. E. United States. I have seen material from the following localities:

Arkansas: Lawrence Co., 4 ♀♀ (CAS); Poyen, Oct. 25, 1948, O. Bryant, 1 ♂ (CAS).

Florida: Brooksville, Jan. 25, 1940, E. C. Van Dyke, 2 ♀♀ (CAS); Gulfport, A. G. Reynolds, 2 ♂♂ (CAS).

Massachusetts: Boston, March 29, 1903, 1 ♂ (CAS).

Mississipi: Agricultural College, April 4, 1915, 1 ♀ (CAS).

North Carolina: Raleigh, June 7, 1905, 1 ♂ (CAS).

Belostoma testaceum (Leidy)
(fig. 6)

Perthostoma testaceum Leidy, 1843, Jour. Acad. Nat. Sci. Phil., (2) 1: 60, 66.

Zaita testaceum Mayr, 1863, Verhandl. Kais.-Konig. Zool.-Bot. Wein, 13: 354.

Belostoma testaceum Bueno, 1905, Jour. N. Y. Ent. Soc., 13: 44; Bueno and Brimley, 1907, Ent. News, 18: 435; Kirkaldly and Bueno, 1909, Proc. Ent. Soc. Wash., 10: 192; Smith, 1910, Ann. Rept. N. J. State Mus., p. 168; Barber, 1914, Bull. Amer. Mus. Nat. Hist., 33: 498; Van Duzee, 1916, Checkl. Hem. Amer., N. Y. Ent. Soc., p. 53; Van Duzee, 1917, Univ. Calif. Publ. Ent., 2: 469; Britton, 1923, Ins. Conn., pt. 4, Conn. State Geol. Nat. Hist. Surv. Bull., no. 34, p. 399; Blatchley, 1926, Het. East. No. Amer., p. 1048; Leonard, 1928, Corn. Univ. Agri. Exp. Sta. Bull., Mem. 101, p. 140; De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 240; Brimley, 1938, Ins. No. Caro., No. Caro. Dept. Agri., p. 84; Hussey and Herring, 1950, Fla. Ent., 33: 84, 155; Herring, 1951, Fla. Ent., 34: 21, 157; Ellis, 1952, Amer. Midl. Nat., 48: 326; Penn, 1952, Proc. Louis. Acad. Sci., 15: 51.

Zaita testacea Mayr, 1871, Verhandl. Kais.-Konig. Zool.- Bot. Ges. Wein, 21: 409, 417; Walker, 1873, Cat. Hem. Het. Brit. Mus., pt. 8, p. 179; Uhler, 1886, Checkl. Hem. Het. No. Amer., Brookl. Ent. Soc., p. 28; Banks, 1910, Cat. Nearct. Hem. Het., Amer. Ent. Soc., p. 10.

Zaitha reticulata Haldeman, 1852, Explor. Surv. Valley Great Salt Lake Utah, Append. C, p. 370; Mayr, 1863, Verhandl. Kais.-Konig. Zool.-Bot. Ges. Wein, 13: 354.

Size: Length, 18-18.5 mm.; width, 9-9.5 mm.

Comparative notes: This species resembles *B. lutarium* and *B. flumineum* most closely but can be easily separated from them by the characteristic pattern of the connexival hair, the smaller size of the bug, and by the fact that the proboscis is not particularly prominent. The shape of the head from the side is approximately like that shown in figure 10. In the few specimens I have seen this species tends to be slightly darker than *lutarium* or *flumineum*.

Data on distribution: I have before me only five specimens. According to literature this species has a distribution similar to that of *B. lutarium*. I have seen specimens from the following localities:

GEORGIA: Savannah, Feb. 10, 1944, R. L. Usinger, 1 ♂, 1 ♀ (Usinger).

VIRGINIA: Quantico, Feb. 13, 1919, Carl D. Duncan, (Usinger).

WASHINGTON, D.C.: Licking Banks, Nov. 19, 1905, O. Heidemann, 1 ♂ (CAS).

Belostoma fusciventre (Dufour)
(fig. 5)

Zaitha fusciventris Dufour, 1863, Ann. Soc. Ent. France, 32: 329; Mayr, 1871, Verhandl. Kais.-Konig. Zool.-Bot. Ges. Wein, 21: 409, 417; Walker, 1873, Cat. Hem. Het. Brit. Mus., pt. 8, p. 179; Uhler, 1875, Bull. U. S. Geol. Geog. Surv. Terr., (2) 1: 338 (in part); Uhler, 1886, Checkl. Hem. Het. No. Amer., Brookl. Ent. Soc., p. 28 (in part); Uhler, 1894, Proc. Calif. Acad. Sci. (2) 4: 291 (questionable record); Champion, 1901, Biol. Centr. Amer., vol. 2, pp. 365-366, pl. 21, figs. 23, 23a (in part); Barber, 1906, Mus. Brooklyn Inst. Arts Sci., Sci. Bull., 1: 288; Banks, 1910, Cat. Nearc. Hem. Het., Amer. Ent. Soc., p. 9 (in part).

Belostoma fusciventris Bueno, 1906, Ent. News, 18: 55; Snow, 1906, Trans. Kans. Acad. Sci., 20: 180 (questionable record); Kirkaldy and Bueno, 1909, Proc. Ent. Soc. Wash., 10: 191 (in part); Van Duzee, 1916, Checkl. Hem. Amer., N. Y. Ent. Soc., p. 53 (in part); Van Duzee, 1917, Cat. Hem. Het., Univ. Calif. Publ. Ent., 2: 468 (in part).

Belostoma fusciventre De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 222, pl. 7, fig. 59 (in part); Usinger, 1956, Aquat. Ins. Calif., p. 206.

SIZE: Length, 18-20.5 mm.; width, 8-9.5 mm.

COMPARATIVE NOTES: This species is not likely to be confused with any other species in our limits except perhaps, *B. bakeri*. Besides the characters given in the key, the following can be used to identify this species: a marginal brown spot in the middle of each connexival plate; terminal hook of transverse suture of pronotum depressed; proboscis not very prominent; head approximately as shown in figure 10; color mainly brown with longitudinal testaceous stripe along thoracic pleura; fore femora nearly all brown but with several small pale spots.

DATA ON DISTRIBUTION: *B. fusciventre* is primarily a Mexican form but has been recorded from Texas to California in the literature. I have seen specimens only from Texas. The records of this species from California are most certainly the result

of misidentifications. It is possible that *B. bakeri* was confused with *fusciventre* by early workers, especially Uhler. Snow's (1906) record for this species was S. E. Arizona and this is within the realm of possibility since *fusciventre* is a Mexican form and can be expected to be found in any of the border states. I have seen specimens from the following locality:

Texas: Brownsville, Oct. 13, 1944, R. L. Usinger, 2 ♂♂, 4 ♀♀ (Usinger).

Belostoma bakeri Montandon
(figs. 4, 7, 10)

Belostoma bakeri Montandon, 1913, Bul. Soc. Rom. Sti. Buc., 22: 123-125; Van Duzee, 1917, Univ. Calif. Publ. Ent., 2: 468; De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 229-230; Essig, 1938, Ins. West. No. Amer., p. 367; Ellis, 1952, Amer. Midl. Nat., 48: 328; Usinger, 1956, Aquat. Ins. Calif., p. 206, fig. 7:16a (mislabeled as *flumineum*).

Size: Length, 16.5-22 mm.; width, 8-10 mm.

Comparative notes: The reader is referred to the excellent figure of this species in Usinger's work, *Aquatic Insects of California*. This species is usually light brown dorsally with the venter tending towards a darker brown, especially the abdominal sternites. This species is very closely related to *B. saratogæ* new species, but the latter is much darker in color. The shape of the caudal filaments distinguishes the two immediately. *Belostoma bakeri* is a variable species. Variation in size and shape is particularly noticable. There appears to be a tendency for an increase in body size as the distribution proceeds northward suggesting a cline. More intensive collecting may reveal that *B. bakeri* is a polytypic species.

Data on distribution: This species ranges from Louisiana to California and northward into Oregon. I have seen specimens from the states of Durango, Sonora, and Baja del Norte in Mexico. Uhler and others apparently confused this species with *fusciventre*. *B. fusciventre* has often been reported from California, Arizona and New Mexico in the literature.* Most surely these

*Uhler, 1875, Rept. Geog. Geol. Expl. Surv. West One Hundredth Merid., 5: 840; Uhler, 1875, Bull. U. S. Geol. Geog. Surv. Terr., (2) 1: 338; Uhler, 1886, Checkl. Hem. Het. No. Amer., Brookl. Ent. Soc., p. 28; Champion, 1901, Biol. Centr. Amer., vol. 2, p. 365; Kirkaldy and Bueno, 1909, Proc. Ent. Soc. Wash., 10: 191; Banks, 1910, Cat. Nearc. Hem. Het., Amer. Ent. Soc., p. 9; Van Duzee, 1916, Checkl. Hem. Amer., N. Y. Ent. Soc., p. 53; Van Duzee, 1917, Univ. Calif. Publ Ent., 2: 468; De Carlo, 1938, Anal. Mus. Arg. Cienc. Nat., 39: 222; Essig, 1938, Ins. West. No. Amer., p. 367.

records are erroneous and the specimens referred to were *bakeri* or *flumineum*. Bank's (1910), record of *apache* (as *minor* of Dufour) from California was probably a misidentification also. De Carlo's (1938) record of *apache* from California was probably based on Bank's record. The type locality of *apache* is Brazil. I have seen *bakeri* from the following localities:

ARIZONA: Pomerene, Nov. 8, 1953, F. S. Truxal and L. Martin, 7 ♂♂, 6 ♀♀ (LACM).

CALIFORNIA: Berkeley, Aug. 29, 1936, M. A. Embury, 1 ♂ (Usinger); Bishop, Aug. 4, 1937, R. M. and G. E. Bohart, 1 ♂, 1 ♀ (CAS); Blocksburg, June 21, 1935, E. Daybell, 1 ♂, 1 ♀ (CAS); Camp Pendleton, Oceanside, Oct. 24, 1945, H. P. Chandler, 1 ♀ (Usinger); Carmel, April 15, 1919, L. S. Slevin, 1 ♂, 1 ♀ (CAS); Cloverdale, June 19, 1926, V. S. Brown, 1 ♀ (CAS); Colton, Feb. 1, 1910, C. R. Pilate, 1 ♀ (CAS); Davis, July 9, 1932, R. L. Usinger, 6 ♂ ♂, 5 ♀ ♀ (Usinger); Fallen Leaf Lake, June 19, 1930, 1 ♀ (Usinger); Fish Slough near Laws, 1937, Miller, 1 ♀ (CAS); Inverness, Oct. 3, 1950, P. D. Ashlock, 1 ♂ (Ashlock); Laguna Dominguez, Los Angeles, Aug. 22, 1953, Lionel Stange, 1 ♀ (Menke); La Habra, Aug. 4, 1916, L. L. Muchmore, 7 ♂♂, 7 ♀♀ (LACM); Lake Britton, Sept. 17, 1946, H. P. Chandler, 1 ♂ (Usinger); Lake Tahoe, July 20, 1920, M. Marshall, 1 ♀ (CAS); Leona Heights, Oakland, Sept. 1924, G. Linsley, 1 ♀ (Usinger); Los Angeles River, May 1930, G. Grant, 1 ♀ (LACM); near Mather, July 31, 1930, E. Zimmerman, 1 ♀ (Usinger); near Moss Beach, Feb. 4, 1928, A. M. A., 2 ♂♂ (Usinger); Oakland, March 4, 1933, E. S. Ross, 1 ♂, 2 ♀♀ (CAS); Hills back of Oakland, Sept. 5, 1909, E. C. Van Dyke, 1 ♂, 1 ♀ (CAS); Olancha, May 18, 1954, F. S. Truxal and L. Martin, 2 ♀♀ (LACM); 2 mi. S. Olema, April 7, 1957, A. Menke and L. Stange, 9 ♂♂, 11 ♀♀ (Menke); Pacific Grove, Sept. 5, 1920, F. E. Blaisdell, 1 ♀ (CAS); Point Reyes, May 2, 1954, P. D. Ashlock, 1 ♂ (Ashlock); Redding Springs, Aug. 19, 1927, 1 ♂ (Usinger); Riverside, Feb. 27, 1927, Thos. Craig, 1 ♂ (CAS); Saltdale, June 19, 1932, A. T. McClay, 1 ♀ (Usinger); San Francisco, Dec. 1, 1945, H. P. Chandler, 1 ♂ (Usinger); San Gabriel River, Oct. 16, 1949, C. L. Hogue, 1 ♀ (Hogue); San Mateo Co., July 4, 1909, J. A. Kusche; 1 ♂, 1 ♀ (CAS); Santa Ana Canyon, June 25, 1926, C. E. Norland, 1 ♂, 2 ♀♀ (LACM); S. Sonoma Co., Oct. 2, 1910, J. A. Kusche, 1 ♀ (CAS); Stanford

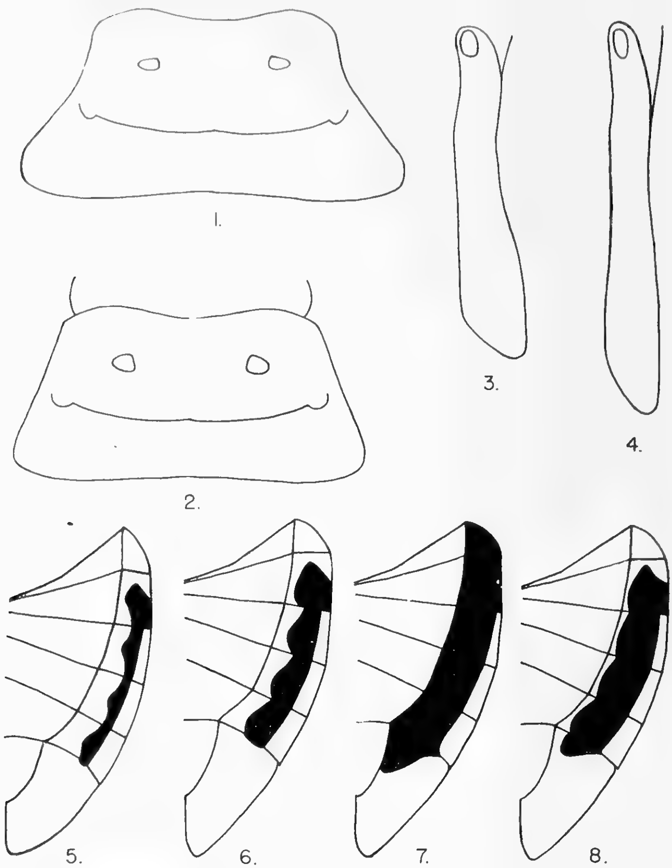

PLATE 47

1. *Belostoma flumineum*: pronotum.
2. *Belostoma bakeri* and *saratogae*: pronotum.
3. *Belostoma saratogae*: ventral aspect of right caudal filament.
4. *Belostoma bakeri*: ventral aspect of right caudal filament.
5. *Belostoma fusciventre*: pattern of hair on connexivum.
6. *Belostoma testaceum*: pattern of hair on connexivum.
7. *Belostoma flumineum, bakeri,* and *saratogae*:pattern of hair on connexivum.
8. *Belostoma lutarium*: pattern of hair on connexivum.

Univ., Oct., 1 ♂, 1 ♀ (CAS); Temecula, Oct. 12, 1954, F. S. Truxal and L. Martin, 1 ♂ (LACM); near Truckee, Aug. 8, 1946, H. P. Chandler, 1 ♀ (Usinger); Warm Sulphur Spring, Panamint Valley, Feb. 24, 1957, A. Menke, 15 ♂ ♂, 22 ♀ ♀ (Menke);

Westwood, May 19, 1933, 1 ♂, 1 ♀ (UCLA); Wilmington, July 29, 1936, R. Boland and R. Mathews, 1 ♂ (LACM); Williams, July 1, 1949, C. H. Spitzer, 1 ♀ (CAS).

OREGON: Chandler State Park, June 30, 1951, Borys Malkin, 1 ♂ (CAS).

NEVADA: Soda Lake, 1933, G. D. Hanna, 1 ♀ (CAS)

TEXAS: Dripping Springs, Aug. 9, 1942, W. S. and E. S. Ross, 1 ♂, 3 ♀♀ (CAS); Rosevelt, April 21, 1924, J. O. Martin, 1 ♀ (CAS).

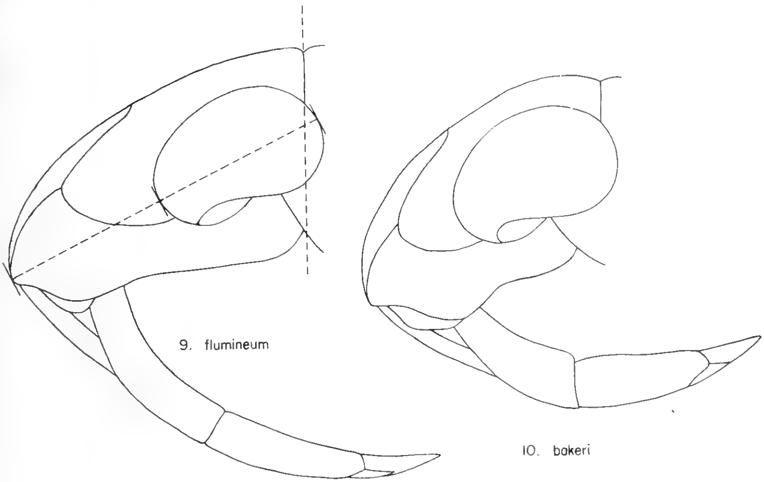

PLATE 48

9. *Belostoma flumineum*: shape of head and beak illustrating method of measuring length of eye to length of proboscis, and the vertical axis of the head.
10. *Belostoma bakeri*: shape of head and beak.

Belostoma saratogæ new species

(figs. 2, 3, 7, 10)

DESCRIPTION HOLOTYPE MALE:

SIZE: Length 18 mm.; width 8.7 mm.

GENERAL APPEARANCE: Narrow from a dorsal aspect. Dorsum dark brown; thoracic venter dark brown; abdominal venter blackish brown except apex which is testaceous. Legs paler than

rest of bug, light brown with dark brown maculations. Proboscis not particularly prominent, rapidly sloping downward.

Head: Base of beak situated at point nearly beneath anterior margin of eye as seen from side. First segment of beak slightly wider than second at apex; proportions of segments as measured on anterior surface: 1.3::1::.75. Clypeus prominent as seen from side of head, base just reaching line drawn between anterior angles of eyes. Interocular space at narrowest point wider than an eye. Vertex with scattered punctures. Inner margins of eyes diverging posteriorly. Post ocular space with setæ that overlap anterior angles of pronotum. Eyes as long as wide. Proportions of head length to width: 2.5::4.35. Proportions of length of proboscis to length of eye: 1::1.4.

Segments of beak testaceous except for reddish tinges at apex and base of third segment. Labrum dark brown basally, becoming testaceous towards apex. Clypeus dull brown. Genæ dark brown. Proboscis on each side of apex of clypeous testaceous, except for extreme tip which is brown. Interocular space shining dark brown. Longitudinal sulcus mesad of each eye blackish brown with a narrow longitudinal testaceous stripe on each side. Post ocular space black brown.

Thorax: a. Prothorax: Pronotum with sides straight. Proportion of median length to greatest width: 3.1::6.8 (overall length = 3.4). Proportion of median length of anterior lobe to posterior lobe: 2.1::1. Anterior and posterior lobes coarsely punctate.

Anterior lobe of pronotum shining dark brown with an M-shaped testaceous spot mesally on anterior margin. Posterior lobe lighter brown on anterior two thirds and dark brown on posterior one third, shining. Five small, evenly spaced, testaceous spots along anterior margin of posterior lobe. Lateral margins of pronotum testaceous. Proepimeron blackish brown except for dorsal margin and antero-ventral area which are testaceous. Prosternal carina low, semicircular, blackish brown.

b. Mesothorax: Mesepisternum blackish brown except for a longitudinal testaceous stripe just above middle of plate. Mesepimeron blackish brown except antero-dorsal angle and posterior lobe which are testaceous. Mesosternum blackish brown and covered with short setæ.

c. Metathorax: Metepisternum blackish brown except for a thin longitudinal testaceous stripe; margin at base of metacoxæ tesselate with testaceous spots. Metasternum (metaxyphus) blackish brown, covered with setæ mesially forming a longitudinal row of hairs; sharply pointed posteriorly.

Legs: a. Prolegs: Coxæ blackish brown with base testaceous. Trochanters testaceous with brown maculations. Femora generally brown but with a faint longitudinal testaceous area mesially, and another such area along the posterior margin, dorsally; ventral surface with two faint testaceous spots on the posterior margin; setæ lining posterior margin brown. Length to width: 4.5::1.5. Tibiæ brown with two equally spaced faint testaceous rings. First tarsal segment testaceous; second segment brown. Claws reddish brown. Proportions of leg including claw: 3.5:: 1.5::4.5::3::.3::.5::.4.

b. Mesolegs: Coxæ brown except posterior lobes which are testaceous. Trochanters testaceous. Femora testaceous but maculated with three wide bands of brown, ventrally; one at base, one midway, and one subapically, on ventral side. Dorsal surface completely suffused with brown with only faint suggestion of testaceous areas corresponding to ventral surface. Ventral surface of tibiæ testaceous but suffused with brown. Dorsal surface light brown. Spines red brown; dorsal swimming hairs brown. Second tarsal segment light brown; third segment light brown becoming dark brown at apex. Tarsal setæ and spines red brown. Claws testaceous basally and red brown apically. Proportions of leg including one claw: 1.9::1.8::5.25::4.2::.7:: 1.1::.75.

c. Metalegs: Coxæ brown except posterior lobes which are testaceous. Tronchanters testaceous. Femora testaceous on ventral sides with faint suffusion of brown; the brown forming three indefinite bands, one sub-basally, one medially, and one subapically. Dorsal sides light brown. Ventral sides of tibiæ dark brown mesially, the margins narrowly testaceous. Dorsal surface dark brown, speckled apically with testaceous spots. Spines reddish; dorsal swimming hairs brown. Second segment of tarsus brown; third segment brown basally becoming blackish brown apically. Spines and setæ of tarsi reddish. Claws testaceous basally and red brown apically. Proportions of leg including one claw: 2::-2.25:: 6.5::6::1::1.25::.8.

Abdominal venter: Visable sternites shining black brown with transverse wrinkling. Genital plate blackish brown basally becoming testaceous at apex. Visable sternal connexival plates black brown where covered with hair; the remainder testaceous. Center of each plate, except last, with a faint brown spot at margin. Margin of last connexival plate with many faint brown spots. Connexival hair black, covering inner two thirds of

connexiva; mesial margin touching sternites. Patch of hair on last connexival plate triangular, touching genital plate, and reaching one half the length of the genital plate.

Scutellum: Black brown. Apical third transversely corrugated. Proportions of the base to lateral margins: 4.25::4.2::4.2. Median length = 3.5.

Hemelytra: Clavus without veins; corium with network of veins. Membrane with eleven veins. Color brown to dark brown depending on conditions of drying. Embolium and remainder of margin testaceous.

Caudal appendages: Inner half brown, outer half testaceous. Covered with long hairs. Apex obliquely truncate. Proportions of right filament: 13::69, ratio = .188 left filament: 13::70, ratio = .185.

Allotype female: Length 18.5 mm.; width 9 mm. Same appearance as male.

Comparative notes: This species is very close to *B. bakeri.* Except for the shape of the caudal filaments (figs. 3, 4) and darker color it resembles *bakeri* very closely. The lateral margins of the pronotum are more divergent in most specimens of *bakeri.*

Variation within the species: Length varies from 17.5 to 19 mm.; width varies from 8 to 9 mm. Teneral specimens are very much lighter in color. The maculations of the legs are not particularly evident in these specimens. Specimens that are darker than average lose many of the testaceous markings of the body. The ratio of the length to width of the caudal appendages varies as given in the key.

Ecological notes: Saratoga Springs, the only known locality for *saratogæ,* is located in Death Valley National Monument approximately 30 miles north of Baker, San Bernardino Co., California. All the specimens of *saratogæ* have been collected in the main pool or the short stream that flows into it. The reader is referred to a paper by Belkin and McDonald (1956) in which the ecology of the spring and surrounding area is excellently described and illustrated.*

Location of types: Holotype male, allotype female and 14 paratypes in the Los Angeles County Museum. 37 paratypes in the collection of the Dept. of Entomology, University of

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*Belkin and McDonald, 1956, Ann. Ent. Soc. Amer., 49: 105-132.

California at Los Angeles. Additional paratypes in the California Academy of Sciences; Snow Entomological Collections, Univ. of Kansas; California Insect Survey, Univ. of California, Berkeley; Usinger Collection; and the author's collection.

SPECIMENS EXAMINED: Saratoga Springs, Death Valley, California; June 16-19, 1954, Belkin and McDonald, 1 ♀ (UCLA); July 28, 1954, Belkin and McDonald, 1 ♀ (UCLA); July 31, 1954, F. S. Truxal, L. Martin, and A. Menke, 2 ♂♂, 2 ♀♀ (LACM); Dec. 1, 1954, R. W. Sabbot, 2 ♂♂ (LACM); Jan. 10, 1955, F. S. Truxal, 2 ♀♀ (LACM); Feb. 19, 1955, J. Belkin, 1 ♂, 2 ♀♀ (UCLA); March 12, 1955, A. Menke and L. Stange, 3 ♂♂, 3 ♀♀ (LACM); March 20, 1955, J. Belkin, 2 ♂♂ (UCLA); April 23-24, 1955, J. Belkin, 3 ♂♂, 1 ♀ (UCLA); May 27-29, 1955, Belkin et al, 10 ♂♂, 16 ♀♀ (UCLA); Dec. 30-31, 1955, A. Menke and L. Stange, 3 ♂♂, 1 ♀ (Menke); Jan. 27, 1957, A. Menke and L. Stange, 5 ♂♂, 11 ♀♀ (Menke); Feb. 23, 1957, A. Menke, 4 ♂♂, 5 ♀♀ (Menke); May 4, 1957, A. Menke and L. Stange, 6 ♂♂, 3 ♀♀ (holotype and allotype series) (LACM).

A Note on *Belostoma apache* Kirkaldy and Bueno.

Apache was proposed as a new name for *B. minor* of Dufour (1863) by Kirkaldy and Bueno (1909). In 1805 Palisot de Beauvois described a species of *Belostoma* from "Saint-Domingue" (Haiti) as *Nepa minor.* Dufour had specimens from Brazil which he thought were the same as *B. minor* of Palisot de Beauvois. The discrepancy in localities makes it improbable that *B. minor* of Dufour is the same as *B. minor* of Palisot de Beauvois. Although this situation was recognized by several authors, no one proposed a new name for Dufour's species until 1909 when Kirkaldy and Bueno gave it the name *apache.* Since Dufour's specimens came from Brazil this must be considered as the type locality for *apache*, and Dufour's description the original. Kirkaldy and Bueno gave no description. *B. apache* (as *minor* Dufour) has been recorded from Mexico by Mayr (1871). Whether or not this is the same species as *apache* remains to be verified. Montandon (1913) describes *B. apache* without giving any locality for his specimens. I have seen specimens from Mexico that agree with Montandon's description. De Carlo (1938) gives Mexico as the locality for specimens he determined as *apache.*

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FRANK ELMER PEABODY, PhD.

1914-1958

"My academic interests revolve around teaching and research in the comparative anatomy and history of vertebrate animals. Boyhood interests in fossil vertebrates led me to related subjects in the curriculum of the University of California, Berkeley . . . There, while working under the inspiring guidance of Professor Charles Lewis Camp, I came to share his enthusiasm for phylogenetic problems in the history of the vertebrates. In my capacity as a graduate teaching fellow, contacts with several hundred

students whetted the desire to teach the history of life and attendant marvels. These early interests in research and teaching have been realized to a satisfying degree at the University of Kansas and at the University of California, Los Angeles. At present, my long range objectives are simple enough, at least in the statement—to continually widen my intellectual horizon in my chosen field by searching out new facts, new ideas, and new syntheses. Correlative objectives are: greater stature as a teacher and researcher, and greater value to my University."

The above was written by Frank Elmer Peabody only a few months before his sudden passing on June 27, 1958. This statement of his philosophy was included as the final comment in a Research Proposal that he had submitted to the National Science Foundation. Such a statement was not necessarily required in the proposal, but appropriately illustrates the high standards that Frank inherently lived by, and he felt compelled to explain this in the research proposal. Just before his death, he was notified of his award of $3,000.00 by the National Science Foundation for a six-months' program of study on "The Phylogeny and Paleoecology of Carboniferous Reptiles."

Frank was born August 28, 1914 in Fenwich, Michigan. He attended high school in Berkeley and San Francisco, California, and graduated in 1932. He obtained his Junior certificate from Golden Gate Junior College in San Francisco, graduating as class valedictorian in 1936. He received a B.A. degree in 1938, an M.A. in Paleontology in 1940, and in 1946, a PhD. in Paleontology; all of this was accomplished at the University of California, at Berkeley. During the war (1943-1945), he was a supervisor of technicians at the Radiation Laboratory at Berkeley and at Oak Ridge.

In 1947-48, Dr. Peabody served as Senior Paleontologist for the University of California South African Expedition. From 1948 to 1955, he was an instructor and then assistant professor of Zoology at the University of Kansas. In the fall of 1955, he joined the staff at the University of California at Los Angeles as assistant professor of Zoology.

He was a member of the Society of Vertebrate Paleontology, Paleontological Society, Society for the Study of Evolution, a fellow of the Geographical Society of America, Society of Ichthyology and Herpetology and fellow of the Southern California Academy of Sciences.

Immediately upon arrival in southern California, Frank became an unusually active member of our Academy. He was always willing to contribute ideas and time to the organization,

serving on the advisory board and was the ever congenial chairman of the Section on Earth Sciences.

Frank constantly pursued his scientific endeavors with intensity, yet his interests were not unidirectional; for example, he enjoyed the unique hobby of model railroad construction, he was an expert on home gardening, and a very talented photographer of still and movie subjects, including his well-known documentary "Search for the Past" or as he explained it, "A fossil, from rock to textbook."

Dr. Peabody is survived by his wife, Anna, whom he married in 1938; three children, Joanne, age 19, Frank, Jr., age 17, and Joyce, age 10; his brother, Van W. Peabody, Jr.; a sister, Madeline W. Peabody; and his father and mother, Mr. and Mrs. Van Peabody; all of California. Everyone admired the fact that whenever possible, Frank and his wife, Anna, jointly participated in his professional activities, and this was particularly well exemplified in their regular attendance at the Academy meetings.

Frank was a very real and stimulating friend, quiet of voice, but inevitably one was was rewarded by listening to what he had to say. He was constantly aware of the urgency for the attainment of professional perfection. His written works are models of scientific achievement, and he had, at the early age of 43, attained distinction as a world authority on fossil reptiles and amphibians, as particularly demonstrated in his classic papers on: Reptile and amphibian trackways; the origin of the astragalus in reptiles; and the primitive Pennsylvanian reptile *Petrolacosaurus*. A total of 25 scientific papers, written by Frank Peabody or co-authors, have been published since 1941, and at the time of his death, two more works were in press and four in manuscript.

Rarely has one man contributed so much to the intellectual prestige of a community in so short a time since his arrival in southern California in the fall of 1955. Those who were privileged to know him, cannot forget him.

THEODORE DOWNS

PROCEEDINGS OF THE ACADEMY

September 19, 1958

The first monthly meeting of the 1958-1959 fiscal year was held in the Education Lecture Hall of the Los Angeles County Museum and was sponsored by the Section on Invertebrate Zoology, Dr. Richard Loomis, Chairman. The speaker of the evening, Dr. Willis E. Pequenat of Pomona College, presented a series of unusually fine color slides under the title "Living Treasures of the Pacific." All of these excellent underwater photographs were taken by Dr. Pequenat himself in the waters off the coast of Corona Del Mar.

Board of Directors

The Board of Directors met immediately following the program for a short business session. Three new applicants for membership were accepted. As their names will appear in the new booklet for the fiscal year, they will not be listed here.

October 24, 1958

The October meeting was held on the 4th Friday owing to a conflict in dates on the 3rd Friday. A tour of the palatial new pharmaceutical plant of the Stuart Pharmaceutical Company in Pasadena, with a catered dinner served in the foyer of the plant, was sponsored by the Committee for Special Events, Henry Anson Wylde, Chairman.

Earth Science Section News

The fourth meeting of the Earth Science Section was held on April 11, 1958 at Long Beach State College, Room 110, Science Building, with 20 present. Several members of the group met at the Hawaiian Restaurant on Pacific Coast Highway prior to the meeting for dinner and informal "shop talk."

There were two evening discussions; the first on "Fossil Vertebrates and Intercontinental Relationships" was led by Dr. John A. White. Dr. White discussed the relationships of New and Old World squirrel faunas and the need for greater emphasis on detailed study of the anatomy of living vertebrates. The second discussion was led by Dr. Richard B. Loomis who remarked on the work of Darlington with regard to centers of origin of anurans.

The last meeting of the Earth Science Section for the 1957-58 season was held on May 30, 1958 at the University of California at Los Angeles in the Zoology department seminar room. Dr. John N. Belkin of the Division of Entomology at U.C.L.A. visited the group and presented a discussion on his extensive studies of recent mosquito distributions, and his interesting views on the probable origins of primitive insect types in the equatorial or "Mediterranean" regions of the world. There were ten participants with general comments led by Dr. Frank E. Peabody. The Academy is greatly indebted to Frank for making the series of meetings, initiated this year by the Earth Science Section, highly successful gatherings. Section meetings are planned for next year, although the untimely death of Frank is a tragic loss to the group and the entire Academy.

The first fall meeting of the Earth Science Section took place at the Los Angeles Museum on October 3, 1958, with 12 in attendance. Robert G. Thomas gave a fine discussion on "The Pleistocene of Coastal Southern California – An Integrated Approach." He emphasized the need for *valid* data from all fields of study including: geology, paleontology, geochemistry, geophysics, paleoecology, paleogeographic distribution, archeology and climatology – in order to arrive at a more complete interpretation of past events, to make predictions of future events and make efficient use of our natural resources today. As one item of deficient data – he noted there is a dearth of evidence, to date, for the presence of early Pleistocene vertebrate faunas in the Los Angeles basin area. This marks one facet of needed investigations of the Pleistocene of our coast. One of the important conclusions derived was that valuable data can be obtained if all *field* investigators have at least some idea of what to preserve; be it artifact, rock or fossil, while they pursue their own particular problems.

Ted Downs served as chairman in the place of the late Frank E. Peabody.

SCIENTIFIC NOTES

RANDOM NOTES ON EARLY STAGES OF LEPIDOPTERA

(Continued from previous issue)

Halisidota davisii Hy. Edw.

Among the items collected by Noel McFarland near Seligman, Arizona, between August 9 and 15, 1956, was a gravid female of *Halisidota davisii*. This produced eggs, which made possible the following fragmentary notes.

The eggs were laid in a single-layered cluster.

EGG: hemispherical, measuring approximately .75 mm. wide by .6 mm. high. The base is flat, and the top gently and regularly rounded. The color is a lustrous golden yellow.

The surface texture appears to be smooth, but under magnification is seen to bear a faint grill-work outlining minute hexagonal cells.

The eggs hatched August 24-25, 1956.

FIRST INSTAR LARVA: length, 2 mm.

The head is jet black, and is slightly larger than the first segment. It is well rounded. The mouth parts are dull yellow, edged with black. The antennae are yellow.

The setae on the head are few in number, short, and colorless.

The body is cylindrical and stout, and dull yellow in color throughout.

There are several longitudinal rows of relatively large black papillae, each topped by a single long black seta. The setae of the cephalic end are longest.

The legs and prolegs are concolorous with the body.

The larvae were offered oak, willow, *Ceanothus* and *Plantago*, all to no purpose.

It is hoped that other collectors in Arizona will obtain larvae of this species and rear them, in order that a record of the metamorphosis may be completed.

Halisidota davisii was originally described in the Proceedings, Calif. Academy of Sciences, Vol. 5, pp. 365, Sept. 7, 1874, the type locality being designated as "Prescott, Arizona".

Holland, in the "Moth Book," p. 137, 1908, listed it as a synonym of *H. cinctipes* Grote. He records the latter as occurring in the Gulf states southward, notwithstanding Henry Edwards' record of *davisii* from Arizona.

Seitz (Vol. 6, American Bombyces and Sphinges, p. 412) lists it as an aberration of *H. cinctipes*, but says that it may be a distinct species.

McDunnough (Check List, #983, p. 48, 1938) lists it as a good species.

JOHN A. COMSTOCK

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